Course Code **18ME1T4**	**ENIGINEERING MECHANICS (Common to All Branches)**	**L**	**T**	**P**	**C**
	Maximum expected contact hours : **60**				
	Prerequisites : **Basic foundation of Mathematics & Physics**	**4**	**--**	**--**	**3**

PURPOSE: To make the students be able to understand the basic laws of physics & Mechanics and to apply them to simple practical problems

INSTRUCTIONAL COURSE OBJECTIVES	
1	To make students understand how to apply Newtonian physics to analyse relatively simple physical mechanisms. - with some emphasis on commonly encountered engineering applications
2	To study the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering
3	To understand the concept of centroid and moment of inertia
4	To be able to understand the effects of friction under static and kinetic conditions.
COURSE OUTCOMES	
1	To make the students able to recognize different force systems, moments and couple.
2	To induce the ability to draw Free Body Diagram and to apply the equations of equilibrium.
3	To study different kinds of beams and to generate the shear force and bending moment diagrams applying variety of loads.
4	To study simple trusses and quantify all forces associated with a static framework.
5	To estimate the effect of friction on bodies in different positions.
6	To learn the concepts of centroid, centre of gravity.
7	To study about rigid body and its analysis
8	To study work, energy and particle motion

UNIT – I

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction, limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction.

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium of Coplanar Systems,

Spatial Systems for concurrent forces. Lamis Theorem, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium, analysis of plane trusses.

UNIT – III

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite

bodies, Pappus theorems.

UNIT IV

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of

Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:**

Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V

Kinematics: Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. **Kinetics:** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT – VI

Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOKS :

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

REFERENCES :

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics, statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics, statics and dynamics – I.H.Shames, – Pearson Publ.
4. Mechanics For Engineers, statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
5. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston –5th Edn Mc Graw Hill Publ.
6. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.
7. Singer's Engineering Mechanics: Statics And Dynamics, K. Vijay Kumar Reddy, J. Suresh Kumar, Bs Publications
8. Engineering Mechanics, Fedinand . L. Singer, Harper – Collins.

Course Code	ENGINEERING DRAWING-I (Common to CSE,ECE,MECH,EEE&CIVIL)	L	T	P	C
18ME2T6	Maximum expected contact hours : **65**	2	--	4	3
	Prerequisites : **Knowledge in Geometry**				

PURPOSE: This course aims to provide the students with basic knowledge of Engineering Drawing which will be useful designing and modelling for industry and practical.

INSTRUCTIONAL COURSE OBJECTIVES	
1	Provide basic conventions and standards used in Engineering Graphics.
2	Impart knowledge on various Engineering curves and their significance.
3	To draw orthographic, sectional and pictorial views of a given solid.
4	To develop skills in three dimensional visualization of engineering components
5	To inculcate CAD packages on modelling and drafting
COURSE OUTCOMES	
1	Familiarize with BIS standards and conventions used in engineering graphics.
2	Draw various engineering curves e.g ellipse, parabola, cycloids and involutes etc and construct various reduced scales e.g plain, diagonal and vernier scales
3	Differentiate between first angle and third angle methods of projection and distinguish parallel and perspective projection.
4	Visualize different views like elevation and plan for a given line, plane figures or solid objects.
5	Apply drafting techniques and use 2D software e.g AutoCAD to sketch 2D plane figures.
6	Identify internal features of an object from the sectional views of the object.
7	Develop the solid surfaces and estimate material required to produce various engineered products like chimney, ducts etc

UNIT I

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles. Conic sections: Parabola, Ellipse and Hyperbola by general methods.

UNIT II

Engineering curves: cycloids, involutes, tangents & normals for the curves.
Scales: Plain scales, diagonal scales and vernier scales.

UNIT III

Orthographic Projections: Horizontal plane, vertical plane, profile plane, importance of reference lines, projections of points in various quadrants.
Projections of straight lines: of lines, lines parallel either to of the reference planes, inclined to both the planes, determination of true lengths, angle of inclination.

UNIT IV

Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT V

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes. Projections of Regular Solids inclined to both planes.

UNIT VI

Isometric Views of planes and simple solids and Conversion of Isometric Views to Orthographic Views

Text Books:

1. Engineering Drawing by N.D. Bhatt/Charotar
2. Engineering Drawing/ N.S.Parthasarathy and Vela Murali/Oxford

References:

1. Engineering Graphics. By Basanth Agrawal/CM Agrawal/McGraw Hill Education
2. Engineering Drawing by K.Venu Gopal/New Age Publications.
3. Computer Aided Engineering Drawing / K Balaveerareddy et al-CBS publishers

Course Code	ENIGINEERING WORKSHOP LAB (Common to All Branches)	L	T	P	C
	Maximum expected contact hours : **30**	**4**	**--**	**--**	**3**
	Prerequisites : **Basic Geometry Skills**				

PURPOSE: To make the students be able to understand the basic skills of Equipment, tools handling and to develop Manufacturing ethics.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To train students towards general machining, carpentry and soldering skills.
2	To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude.
COURSE OUTCOMES	
1	Ability to design and model different prototypes in the carpentry trade such as Cross lap joint, T-Lap joint.
2	Ability to design and model various basic prototypes in the trade of fitting such as Square fit, V- fit.
3	Ability to make various basic prototypes in the trade of Tin smithy such as Square tray, and Taper Tray.
4	Ability to perform various basic House Wiring techniques
5	Ability to design and join various prototypes using the technique of soldering

List of Experiments:

Carpentry:

1. T-Lap Joint
2. Cross Lap Joint

Fitting:

1. Vee Fit
2. Square Fit

Soldering:

1. Soldering of Square Tray
2. Soldering for Frustum of Cone

House Wiring:

1. Parallel / Series Connection of three bulbs
2. Stair Case wiring/Godown Wiring

Tin Smithy:

1. Taper Tray
2. Square Box without lid

Course Code	METALLURGY & MATERIAL SCIENCE	L	T	P	C
18ME3T1	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : Basic Mechanical Engineering				

PURPOSE: This course aims at study of fundamentals of crystallography, metallurgy, heat treatment and mechanical properties of materials

	INSTRUCTIONAL COURSE OBJECTIVES
1	To study the concepts of basic structure and crystal arrangement of materials.
2	To study the Phase Diagrams.
3	To study the basic difference between Cast Irons and Steels, their properties and practical applications
4	To study the advantages of heat treatment and the method of heat treatment processes.
5	To study the properties and applications of widely used non-ferrous metals and alloys.
6	To understand the powder metallurgy processes, the need and application of Ceramic and composite materials.
	COURSE OUTCOMES
1	Students are able to Identify the properties of metals with respect to crystal structure and grain size.
2	Students are able to Classify, construct and analyze equilibrium diagrams.
3	Students are able to Classify and Distinguish different types of cast irons, steels and their Applications.
4	Students are able to Describe the concept of heat treatment of steels & strengthening mechanisms.
5	Students are able to Analyze and distinguish various ferrous, non-ferrousmetals and alloys.
6	Students are able to Understand the Principles of Powder Metallurgy and manufacturing Methods of different types of Composites.

UNIT-I- INTRODUCTION:

Structure Of Metals: Introduction to metallurgy, Mechanical properties of materialsBonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal/ alloys – determination of grain size.

Constitution of Alloys: Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

UNIT-II- PHASE DIAGRAMS: Equilibrium cooling and heating of alloys, lever rule, coring Miscibility gaps, Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Study of important binary phase
diagrams of Cu-Ni-, Bi-Cd, Pb-Sn and Fe-Fe3C equilibrium diagram.

UNIT-III-Cast Irons and Steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels..

UNIT-IV- HEAT TREATMENT OF ALLOYS: Annealing, normalizing and hardening. Construction of
TTT diagram for eutectoid steel. Harden ability-determination of harden ability by jominy end
quench test. Surface - hardening methods and age hardening treatment and Cryogenic treatment of alloys.

UNIT-V- NON-FERROUS METALS AND ALLOYS: Structure and properties of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

UNIT-VI- POWDER METALLURGY: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy.

CERAMIC AND COMPOSITE MATERIALS: Crystalline ceramics, glasses, cermets, abrasive materials, nanomaterials – definition, properties and applications of the above.

Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C – C composites.

Text Books:

1. Kodgirie .V.D and Kodgirie.S.V, “Material Science and Metallurgy”, Thirty-seventh Edition, Everest House Publication, 2015.

2. Raghavan.V, “ Material Science and Metallurgy” ,Fifth Edition, PHI Learning Pvt Limited,2013

Reference Books:

1.Donald R. Askeland, the Science and engineering of Materials Cengage learning

2.B.K.Agarwal, “Introduction to Engineering Materials”, Tata McGraw Hill-1stEdition.

3.V. Raghavan, “Material Science and Engineering”, PHI Learning - 5th Edition.

4.R.K.Rajput, “Engineering Materials and Metallurgy”, - S.Chand - 1st Edition-2011

5.William D. Callister, “Materials Science and Engineering”, John Wiley & Sons Inc-2010.

Course Code	THERMODYNAMICS	L	T	P	C
18ME3T3	Maximum expected contact hours : **64** Prerequisites : **Basic Mechanical Engineering**	4	--	--	3

PURPOSE: To understand the basic concepts of energy conversions and fundamentals of thermodynamics and its application.

	INSTRUCTIONAL COURSE OBJECTIVES
1	The student should be able to understand the basic concepts like thermodynamic system, its boundary and related fundamental definitions. Distinction between point function and path function shall be made with respect to energy, work and Heat.
2	To acquire the knowledge of first law of thermodynamics and its analysis.
3	To learn the second law of thermodynamics and significance of entropy principles.
4	To understand the concept of entropy, availability and irreversibility. Should be able to understand the use of Maxwell's relations and thermodynamic functions.
5	To learn the concepts of reactant, non-reactant gas mixtures and pure substance.
6	To understand the significance of various thermal cycles.
	COURSE OUTCOMES
1	Students are able to understand the basic concepts of thermodynamics and differentiate between work and heat forms of energy
2	Students shall be able to Apply the first law of thermodynamics to various thermal systems for analysis.
3	Understand the Second law of thermodynamics and
4	Students shall be to concepts of entropy, energy and irreversibility.
5	Evaluate the performance parameters of thermodynamic cycles, pure substances and gas mixtures.
6	Student shall be able to Apply ideal cycle analysis to simple heat engines to estimate various performance parameters.

UNIT-I-INTRODUCTION: Basic Concepts : System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale.

UNIT-II-FIRST LAW OF THERMODYNAMICS: Joule's Experiments – First law of Thermodynamics Energy A Property of System, First Law Analysis of Closed System, corollaries of first law, various Thermodynamic processes, Different Forms of Stored Energy –Energy Balance, Internal Energy, Specific Heat, Enthalpy, Entropy, PMM1, first law of thermodynamics applied to open system, Steady Flow Engineering Devices-Nozzles, Diffusers, Turbine, Compressors, Throttling Valves, Heat Exchangers.

UNIT-III-SECOND LAW OF THERMODYNAMICS: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, PMM of Second kind, Carnot's principle-Corollaries, Carnot cycle and its specialties, Thermodynamic scale of Temperature.

UNIT-IV-ENTROPY: Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT-V-PROPERTIES OF PURE SUBSTANCE:P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer.

UNIT-VI–Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Text Books:

1. P.K.Nag, "Engineering Thermodynamics" 6th edition, Tata McGraw Hill Education Private Limited, 2017.

2. Yunus A. Cengel M. and Michael A. Boles, "Thermodynamics- An Engineering Approach", 8th edition, McGraw Hill Education (India) Private Limited, 2014.

3.Mahesh M Rathore, Thermal Engineering, McGraw Hill Publications - 2012.

Reference Books:

1. J.P.Holman, Thermodynamics, McGraw Hill Publications -2003.

2. Cengel & Boles, Thermodynamics, Tata McGraw Hill Publications - 2009.

3. V.P. Vasandani and D.S. Kumar "Treatise on Heat Engineering" Metropolitan book Co Pvt Ltd , 2000

4. K Ramakrishna, Engineering Thermodynamics, Anuradha Publishers – 2003

Course Code	MECHANICS OF SOLIDS	L	T	P	C
18ME3T4	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : **Basic Mechanical Engineering**				

PURPOSE: This course aims at study to analyze the stresses & deformations in mechanical members due to various loads.

INSTRUCTIONAL COURSE OBJECTIVES	
1	The student will acquire the fundamental concepts of deformable bodies.
2	The student will describe force-deformation, and stress-strain relationships for isotropic materials.
3	The student will be able to analyze axially loaded members, beams, plane trusses, thin and thick cylinder for induced stresses, strains and deformations under static loads

COURSE OUTCOMES	
1	Calculate stresses, strains and deflections in structural members subjected to various types of loadings.
2	Students are able to Analyze the variation of SF & BM in determinate beams.
3	Students are able to Analyze the structural members subjected to flexural and torsional loads.
4	Students are able to Analyze the biaxial stresses developed at a point of stressed member and identify shear stresses across the cross section of a beam.
5	Students are able Evaluate deflections for statically determinate beams and analyze the thin and thick pressure vessels.

UNIT-I-**Elasticity and plasticity** – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact andshock loadings.

UNIT-II-**SHEAR FORCE AND BENDING MOMENT :** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT-III-**FLEXURAL STRESSES :** Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections likerectangular, circular, triangular, I, T angle sections.

UNIT-IV- **DEFLECTION OF BEAMS :** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, Statically Indeterminate Beams and solution methods.

UNIT-V- **THIN CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

THICK CYLINDERS: –lame's equation – cylinders subjected to inside & outside pressures compoundcylinders.

UNIT-VI-TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

COLUMNS: Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations ofEuler's Formula, Rankine's Formula,

Text Books:

1. Strength of materials /GH Ryder/ Mc Millan publishers India Ltd
2. Solid Mechanics, by Popov
3. Mechanics of Materials/Gere and Timoshenko, CBS Publishers

Reference Books:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol-III, by S.B.Junnarkar.
4. Strength of Materials by S.Timoshenko

Course Code	ENGINEERING DRAWING -II	L	T	P	C
18ME3T2	Maximum expected contact hours : **64**	2	--	4	3
	Prerequisites : **Knowledge in ED-I**				

PURPOSE: To enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modelling.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To study the concepts of combining solids, and generation of definite curve at their intersection.
2	To provide the knowledge of sections of solids and development of surfaces that are required in designing and manufacturing of the objects.
3	To provide a realistic 3D View of an object and make the students able to draw it.
4	To make the students understand the basics of 2D Modelling , View ports and viewpoints.
5	To understand Isometric, orthographic and modelling of simple solids
COURSE OUTCOMES	
1	Students are to develop and interpolate various complex solid objects.
2	Students are able to generate perspective views for various simple figures.
3	Students will be able to design and solid and also combine different solids.
4	Students will be able to understand the paper-space environment thoroughly.
5	The students can create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.

UNIT-I

SECTIONS OF SOLIDS: Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

DEVELOPMENT OF SURFACES: Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid Cone and their parts.

UNIT-II

INTERPENETRATION OF RIGHT REGULAR SOLIDS: Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone

UNIT-III

PERSPECTIVE PROJECTIONS: Perspective View: Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods (General Method only).

UNIT-IV

TYPES OF MODELING: Object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling.

UNIT-V

VIEW POINTS AND VIEW PORTS: View point coordinates and view(s) displayed, examples to exercise different options like save restore, delete, joint, single option.

UNIT-VI

COMPUTER AIDED SOLID MODELING: Isometric projections, orthographic projections of isometric projections, modeling of simple solids, Modeling of Machines & Machine Parts

Text books:

1. Engineering Graphics by John,K.C., PHI Publications, New Delhi, 2009.
2. Machine Drawing, (3rd edition) Narayana,K.L., Kannaiah,P. and Venkata reddy,K., New Age International Publishers, 2010.

Reference books:

1. "AutoCAD 2009", Galgotia Publications, New Delhi, 2012.
2. Text book of Engineering Drawing with Auto-CAD, (4th edition) by Venkata Reddy, K., B.S. Publications, 2009.
3. Engineering drawing, (38th edition) by Bhatt, N.D., Anand Charotar Publications, 1997.

Course Code	ENGINEERING ECONOMICS	L	T	P	C
18ME3T5A	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : Management Science				

PURPOSE: This course aims at study of three phase systems, transient analysis, network synthesis and fourier analysis for the future study and analysis of power systems.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To understand the concept and nature of Managerial Economics and its relationship with other disciplines.
2	To understand the Concept of Demand and Demand forecasting, Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis..
3	To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles
4	To understand the realization of electrical network function into electrical equivalent passiveelements.
5	To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
6	To understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.
COURSE OUTCOMES	
1	Students are able to learn with the knowledge of estimating the Demand and demand elasticity's for a product
2	Students are able understand the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
3	One is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
4	Students are able to learn and prepare Financial Statements and the usage of various Accounting tools for Analysis
5	Students are able to to evaluate the best alternative from various capital budgeting options and calculate.

UNIT-I- Introduction to Managerial Economics and demand Analysis:
Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

UNIT-II-Production and Cost Analysis:
Concept of Production function- Cobb-Douglas Production function- Leontief production function - Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(simple problems)-Managerial significance and limitations of Breakeven point.

UNIT-III-Introduction to Markets, Theories of the Firm & Pricing Policies:
Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Priceand Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods ofPricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing,Usage sensitive pricing) and Priority Pricing.UNIT-IV Two Port Networks: Two port network parameters – Z, Y, ABCD and Hybrid parameters and their relations, Cascaded networks - Poles and zeros of network functions.

UNIT-IV-Types of Business Organization and Business Cycles:
Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms – Business Cycles : Meaning and Features – Phases of a Business Cycle.

UNIT-V- Introduction to Accounting & Financing Analysis:
Introduction to Double Entry Systems – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow statements (Simple Problems)

UNIT-VI- ***Capital and Capital Budgeting:*** Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Text Books:

1. ENGINEERING ECONOMICS, R. Panneerselvam, 2ndEdition, PHI Learning Pvt. Ltd, 2013
2. Managerial Economics and Financial Analysis, by J.V.Prabhakar Rao, Maruthi Publications, 2011

Reference Books:

1. Managerial Economics and Financial Analysis, by A R Aryasri, TMH 2011.
2. Management- Aglobal Entrepreneurial Perspective,Weihrich,Cannice,Koontz, 13th Edition, Tata Mc Graw Hill.2012.
3. Financial Accounting, SN Maheswari, SK Maheswari, Vikas Publishing House Pvt Ltd., New Delhi, 4th Edition,2006.
4. Managerial Economics by Suma damodaran, Oxford 2011.
5. Managerial Economice and Financial Analysis by S.A. Siddiqui & A.S. Siddiqui, New Age International Publishers, 2011.
6. Engineering economy- Theusen & Theusen, 8th edition,1993,Prentice Hall.

Course Code	MECHANICS OF SOLIDS & METALLURGY LAB	L	T	P	C
18ME3L2	Maximum expected contact hours : **30**	--	--	3	1
	Prerequisites : **Basic Mechanical Engineering And Material Science**				
PURPOSE: This course aims at study To familiarize the students with the use equipment's to determine mechanical Properties of materials to acquire the knowledge in Material Testing.					

Twelve Experiments out of the following are to be performed
(6 from MOS Lab and 6 from Metallurgy Lab):

(A) MECHANICS OF SOLIDS LAB

INSTRUCTIONAL COURSE OBJECTIVES	
1	To determine experimentally the mechanical properties of materials.
2	To impart practical exposure on the microstructures of various materials and their hardness evaluation.
3	Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.
COURSE OUTCOMES	
1	Students are able to determine the young's modulus ,rigidity modulus of materials and stresses induced in bars and beams of uniform cross section
2	Students are able to determine the hardness number.
3	Students are able to determine the stiffness of spring.
4	Students are able to determine the impact strength of materials.
5	Students are able to determine the shear stress under single shear and double shear.

List of Experiments:

To determine

1. **Tension Test on UTM** - Determination of the strength, percentage elongation and percentage reduction in area of the given specimen
2. **Deflection Test on Simply supported beam** - Determination of Young's modulus of Simply Supported beam material
3. **Deflection Test on Cantilever beam** - Determination of Young's modulus of cantileverbeam material
4. **Torsion Test** – Determination of modulus of rigidity of circular rod.
5. **Brinnell's Hardness Test** - Determination of Hardness Number for given specimen.
6. **Rockwell Hardness test** - Determination of Hardness Number for given specimen.
7. **Izod Impact Test** - Determination of impact strength of given specimen.
8. **Charpy Impact Test** - Determination of impact strength of given specimen.
9. **Tests on helical spring** - Determination of Modulus of Rigidity of Helical spring material.
10. **Double shear Test** - Determination of shear strength of given specimen.

(B) METALLURGY LAB

INSTRUCTIONAL COURSE OBJECTIVES	
1	To determine experimentally the mechanical properties of materials.
2	To impart hands on training in preparation of metal specimens so as to observe the microstructure.
COURSE OUTCOMES	
1	Students are able to preparing the Specimen using rough grinding, finish grinding and polishing.
2	Students are able to use different types of etchants to expose the microstructure of metal and alloys.
3	Students are able to observing the microstructure and ascertaining the same.
4	Students are able to performing Jominy End Quench test

List of Experiments:

1. Preparation and study of the microstructure of Iron and steels
2. Preparation and study of microstructure of Cast Irons
3. Preparation and study of the microstructure of Copper and its alloys
4. Preparation and study of microstructure of Aluminum and its alloy
5. Study of microstructure of various treated and untreated steels.
6. Hardenability of Steels by Jominy end Quench test.
7. Hardness of various treated and untreated steels.

Course Code	Basic Electrical &Electronics Engineering.	L	T	P	C
18ME3L1	Maximum expected contact hours : **30**	--	--	3	1
	Prerequisites : **Basic Electrical &Electronics Engineering.**				
PURPOSE: This course aims at study of Information to supplement to the Electrical & Electronics Engineering courses and the ability to conduct testing and experimental procedures on Circuits					

Section A: Electrical Engineering

INSTRUCTIONAL COURSE OBJECTIVES	
1	To predetermine the efficiency of dc shunt machine using Swinburne's test.
2	To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests
3	To obtain performance characteristics of DC shunt motor &3-phase induction motor.
4	To find out regulation of an alternator with synchronous impedance method.
5	To control speed of dc shunt motor using speed control methods.
6	To find out the characteristics of PN junction diode & transistor
7	To determine the ripple factor of half wave & full wave rectifiers.
COURSE OUTCOMES	
1	Students are able to find out the efficiency of dc shunt machine without actual loading of the machine.
2	Students are able to able to estimate the efficiency and regulation for different load conditions and power factors of single phase transformer with OC and SC test.
3	Students are able to able to analyse the performance characteristics and to determine efficiency of DC shunt motor &3-phase induction motor.
4	Students are able to able to pre-determine the regulation of an alternator by synchronous impedance method.
5	Students are able to able to control the speed of dc shunt motor using speed control methods.
6	Students are able to find out the characteristics of PN junction diode & transisto
7	Students are able to determine the ripple factor of half wave & full wave rectifiers.

List of Experiments:

The following experiments are required to be conducted as compulsory experiments:

To determine

1. Swinburne's test on D.C. Shunt machine (Predetermination of efficiency of a given D.C.Shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors).
3. Brake test on 3-phase Induction motor (Determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by
a) Armature Voltage control b) Field flux control method
6. Brake test on D.C. Shunt Motor.

Section B: Electronics Engineering.

List of Experiments:

The following experiments are required to be conducted as compulsory experiments:

1.PN junction diode characteristics a) Forward bias b) Reverse bias (Cut in voltage and resistance calculations)
2. Transistor CE characteristics (Input and output)
3. Half wave rectifier with and with out filters.
4. Full wave rectifier with and with out filters.
5. CE amplifiers.
6. OP- Amp applications (inverting, non inverting, integrator and differentiator)

Course Code	AUTO CAD LAB	L	T	P	C
18ME3L3	Maximum expected contact hours : **64**	--	--	3	1
	Prerequisites : **Knowledge in**				

PURPOSE: This course aims at study to enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modelling.

INSTRUCTIONAL COURSE OBJECTIVES	
1	The objective is to introduce various commands in AutoCAD to draw the geometric entities and to create 2D and 3D wire frame models.
2	By going through this topic the student will be able to understand the paper-space environment thoroughly
3	The objective is to make the students create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.
COURSE OUTCOMES	
1	Students are able to determine the young's modulus ,rigidity modulus of materials and stresses induced in bars and beams of uniform cross section
2	Students are able to determine the hardness number.
3	Students are able to determine the stiffness of spring.
4	Students are able to determine the impact strength of materials.
5	Students are able to determine the shear stress under single shear and double shear.

SYLLABUS

UNIT-1-
INTRODUCTION TO COMPUTER AIDED DRAFTING: Generation of points, lines, curves, polygons, dimensioning. Types of modeling : object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling,.
UNIT-II
VIEW POINTS AND VIEW PORTS: view point coordinates and view(s) displayed, examples to exercise different options like save, restore, delete, joint , single option.
UNIT-III-
COMPUTER AIDED SOLID MODELLING: Isometric projections, orthographic projections of isometric projections, Modeling of simple solids, Modeling of Machines & Machine Parts.
UNIT-IV- 2-D Exercises Minimum Eight Diagrams.
UNIT –V-3-D Exercises Minimum Eight Diagrams.

Text Books :
1. Engineering drawing by N.D Bhatt, Charotar publications.
2. Engineering Graphics, K.C. john, PHI Publications

References:
1. Mastering Auto CAD 2013 and Auto CAD LT 2013 – George Omura, Sybex
2. Auto CAD 2013 fundamentals- Elisemoss, SDC Publ.
3. Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas
4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age
5. Text book of Engineering Drawing with auto-CAD , K.Venkata Reddy/B.S . publications.
6. Engineering Drawing with Auto CAD/ James D Bethune/Pearson Publications
7. Engineering Graphics with Auto CAD/Kulkarni D.M, Rastogi A.P, Sarkar A.K/PHI Publications

Course Code	FLUID MECHANICS AND HYDRAULICS	L	T	P	C
18ME4T1	Maximum expected contact hours : **64** Prerequisites : **Knowledge in Mathematics**	**3**	**1**	**--**	**3**

PURPOSE: The aim of this course is to introduce and explain basic fundamentals of fluid mechanics, which is used in applications of Aerodynamics, Hydraulic, Marine Engineering, Gas Dynamics etc.,

	INSTRUCTIONAL COURSE OBJECTIVES
1	To learn fluid properties and hydrostatic law – to understand the importance of flow measurement and its applications in Industries and to obtain the loss of flow in a flow system.
2	To understand the development of boundary layers and advancement of practical hydraulics and understanding the concept of advanced fluid mechanics.

	COURSE OUTCOMES
1	To find frictional losses in a pipe when there is a flow between two plates.
2	Calculate the conjugate depths in a flow.
3	Analyze the model and the prototype.
4	Find the dependent and independent parameters for a model of fluid flow.
5	Explain the various methods available for the boundary layer separation.

UNIT-I Fluid Statics: Dimensions and units: physical properties of fluids – specific gravity, Viscosity and its significance, surface tension, capillarity, vapour pressure. Atmospheric, gauge and vacuum pressure, measurement of pressure. Manometers, Piezometers, U-Tube, Inverted and differential manometers. Pascal's law, hydrostatic law. Buoyancy and floatation: metacentre, stability of floating body, submerged bodies. Calculation of metacentre height. Stability analysis and applications.

UNIT-II Fluid Kinematics: Introduction, Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline, stream tube, stream function and Velocity potential, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow. .

UNIT- III: Fluid Dynamics: surface and body forces, Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend. **Closed conduit flow:** Reynolds's experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line – hydraulic gradient line.

UNIT-IV Boundary layer theory: Laminar flow and Turbulent flow – Boundary layer thickness – momentum – Integral equation – Drag and lift-Separation of boundary layer-Methods of separation of boundary layer.

UNIT-V Dimensional Analysis theorems: Non-dimensional π Dimensional homogeneity, similitude and modelling, dimension less numbers – Rayleigh and Buckingham $\prod$ methods – Model laws and distorted models-Unit quantities-Specific quantities

UNIT-VI Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Text Books:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.
3. Fluid Mechanics and Hydraulic Machines/ RK Bansal/Laxmi Publications (P) Ltd.

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
4. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley ,John Wiley & Sons Inc.
2004 (Chapter 12 – Fluid Flow Measurements)
5. Fluid Mechanics and Hydraulic Machines by Domkundwar & Domkundwar, Dhanpatrai & Co.

Course Code	THEORY OF MACHINES-I	L	T	P	C
18ME4T2	Maximum expected contact hours : **64** Prerequisites :**Engineering Mechanics**	**4**	**0**	**0**	**3**

PURPOSE: The main objective of this course is to identify the basic components & layout of mechanisms and understand the kinematics of linkages in the machines.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To understand develop the mechanisms from the basic concepts for links, pairs and chains.
2	To Understand the velocity and accelerations of various kinematic links in a mechanism
3	To know and analyse cams for producing a desired motion and cams with specified contours.
4	The objective of this unit is to make student understand gears, power transmission through different types of gears including gear profiles and its efficiency.
5	The objective of this unit is to make student understand various power transmission mechanisms and methodologies and working principles. Students are exposed to merits and demerits of each drive.
COURSE OUTCOMES	
1	Develop the mechanisms from the basic concepts for path and function generation
2	The student will get the different types of steering mechanisms, Davis Steering gear, Ackerman's steering gear
3	The student will get, Velocity and acceleration analysis of for a given mechanisms, Kleins construction, Coriolis acceleration.
4	The student will understood law of gearing, Form of teeths like cycloidal and involute profiles
5	The student will understood the industrial scenario like belts, gear trains.

UNIT-I MECHANISMS : Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained . Grublers criterion , Grashoff's law , Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

UNIT-II LOWER PAIR MECHANISM: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling–application–problems.

UNIT-IIIKINEMATICS: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

Plane motion of body: Instantaneous centre of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

UNIT-IV CAMS:- Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

UNIT-V GEARS: Higher pairs, friction wheels and toothed gears–types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing

UNIT-VI Power Transmissions: Introduction, Belt and rope drives, selection of belt drive- types of belt drives,V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length,

angular speed ratio, classification of chains.
Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

Text Books:

1. Theory of Machines-R.S. Khurmi-S.Chand Publishing
2. Theory of Machines – S. S Rattan- TMH
3. Theory of machines and Mechanisms – J.J Uicker, G.R.Pennock & J.E.Shigley - Oxford publishers.

References:

1. Theory of Machines Sadhu Singh, Pearsons Edn
2. Theory of machines and Machinery /Vickers /Oxford .
3. Theory of Machines by Thomas Bevan/ CBS

Course Code	MANUFACTURING PROCESS	L	T	P	C
18ME4T3	Maximum expected contact hours : **64** Prerequisites :**Basic Mechanical Engineering**	**3**	**1**	**0**	**3**
PURPOSE: The main objective of the course is to understand the various production or manufacturing processes which could be done in real time, appreciate the importance of basic principles of Manufacturing Technology.					
INSTRUCTIONAL COURSE OBJECTIVES					
1	The student will understand the primary manufacturing concepts like casting, welding, forming, forging andExtrusion				
2	To know the various manufacturing processes such as casting and welding, welding and forming, forming and forging				
3	To know the working principles of primary manufacturing processes				
4	To understand, design and fabrication of engineering components using different manufacturing processes				
5	The student will Evaluate the manufacturing processes being utilized in the present industrial scenario.				
COURSE OUTCOMES					
1	Design patterns, Gating, runner and riser systems				
2	Select a suitable casting process based on the component				
3	Learn various arc and solid state welding processes and select a suitable process based on the Application and requirements				
4	Understand various bulk deformation processes				
5	Understand various sheet metals forming and processing of plastics				

UNIT – I *CASTING:* Steps involved in making a casting – Advantage of casting and its applications. - Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating, Gating ratio and design of Gating systems

UNIT – IIMethods of melting and types of furnaces, Solidification of castings, Solidification of pure metals and alloys, short & long freezing range alloys. Risers – Types, function and design, casting design considerations, Basic principles and applications of Centrifugal casting, Die casting and Investment casting.

UNIT – IIIWelding : Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, Submerged arc welding, Inert Gas welding- TIG & MIG welding.

UNIT – IV Resistance welding, Solid state welding processes- Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma welding, Laser welding, electron beam welding, Soldering & Brazing.
Heat affected zones in welding; pre & post heating, Weldability of metals, welding defects – causes and remedies – destructive and non destructive testing of welds, Design of welded joints.

UNIT – V Plastic deformation in metals and alloys, Hot working and Cold working, Strain hardening and Annealing. Bulk forming processes: Forging - Types Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.
Introduction to powder metallurgy – compaction and sintering, advantages and applications.

UNIT – VI **Sheet metal forming**- Blanking and piercing, Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.
High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.
Processing of Plastics: Types of Plastics, Properties, Applications and their processing methods, Blow and Injection moulding.

References:

1) Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd
2) Process and materials of manufacture- Lindberg- PHI
3) Production Technology- R.K. Jain- Khanna
4) Production Technology-P C Sharma-S. Chand
5) Manufacturing Processes- H.S. Shaun- Pearson
6) Manufacturing Processes- J.P. Kaushish- PHI

Text Books:

1) Manufacturing Processes for Engineering Materials - Kalpakjain S and Steven R Schmid- Pearson Publ , 5th Edn.
2) Manufacturing Technology -Vol I- P.N. Rao- TMH

Course Code	MACHINE DRAWING (ELECTIVE-II)	L	T	P	C
18ME4T5A	Maximum expected contact hours : **64**	2	0	4	4
	Prerequisites :**Engineering Drawing**				

PURPOSE: The main objectives of the course are to familiarize the basic conventions and various machine elements used in design and to understand the assembly drawings for engine parts, machine parts, valves etc.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To know the comprehend basic conventions needed for machine drawing
2	To understand the conventions of machine elements while designing standardized parts
3	The student will have the ideas and make design calculations correctly.
4	To understand, design and fabrication of engineering components, Gear pump, Fuel pumps Petrol Engine connecting rod, piston assembly.
5	Design the drawings of mechanical components and their assemblies
COURSE OUTCOMES	
1	Develop and/or comprehend basic conventions needed for machine drawing
2	Apply the conventions of machine elements while designing standardized parts
3	Apply the ideas and make design calculations correctly
4	Understand various machine elements Screws jacks, Machine Vices Plummer block, Tailstock.
5	Design the drawings of mechanical components and their assemblies

Machine Drawing Conventions:

1) Need for drawing conventions – introduction to IS conventions
2) Conventional representation of materials, common machine elements and parts such asscrews, nuts, bolts, keys, gears, webs, ribs.
3) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
4) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
5) Title boxes, their size, location and details - common abbreviations & their liberal usage
6) Types of Drawings – working drawings for machine parts.

PART-A

I. Drawing of Machine Elements and simple parts

Objective: To provide basic understanding and drawing practice of various joint, simple mechanical parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportion.

a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
b) Keys, cotter joints and knuckle joint.
c) Riveted joints for plates
d) Shaft coupling, spigot and socket pipe joint.
e) Journal, pivot and collar and foot step bearings.

PART-B

II. Assembly Drawings:

Objective: The student will be able to draw the assembly from the individual part drawing.
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.
a) Engine parts –Gear pump, Fuel pump Petrol Engine connecting rod, piston assembly.
b) Other machine parts - Screws jacks, Machine Vices Plummer block, Tailstock.
c) Valves: spring loaded safety valve, feed check valve and air cock, Control valves

NOTE: First angle projection to be adopted. The student should be able to provide working drawings of actual parts. End semester examination for 70 Marks, Part A- 20 Marks (Answer two questions out of three), Part B- 50 Marks (Assembly Drawing).

Text Books:

1. Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry - TMH
2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers

References:

1. Machine Drawing – P.S.Gill,
2. Machine Drawing – Luzzader
3. Machine Drawing – Rajput
4. Machine Drawing – KC John, PHI
5. Machine Drawing – B Battacharya,

Course Code	APPLIED THERMODYNAMICS	L	T	P	C
18ME4T4	Maximum expected contact hours : **64** Prerequisites : Thermodynamics	**3**	**1**	**0**	**3**

PURPOSE: To make the student learn and understand the reasons and affects of various losses that occur in the actual engine operation	
INSTRUCTIONAL COURSE OBJECTIVES	
1	To familiarize the student with the various engine systems along with their function and necessity.
2	To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to find the several engine operating parameters that affect the smooth engine operation.
3	To make the student learn to perform testing on S.I and C.I Engines for the calculations of performance and emission parameters.
4	To make students learn about different types of compressors and to calculate power and efficiency of reciprocating compressors.
5	To make students learn mechanical details, and to calculate power and efficiency of rotary compressors
COURSE OUTCOMES	
1	To determine the various types of engines and its performance
2	Describe the components and functioning of a Rankine cycle and compressors.
3	Apply thermodynamic analysis to study the behavior of Reciprocating compressors
4	Describe various thermal systems using thermodynamic laws and principles
5	Comprehend the concepts of heat, work, forms of energy, laws of thermodynamics, mixture of gases, and thermodynamics cycles.

UNIT – I BASIC CONCEPTS: Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating. combustion: fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, Stoichiometry, flue gas analysis.

UNIT- II BOILERS: Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance.

UNIT – III BOILER DRAUGHT: Draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.

STEAM NOZZLES: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line.

UNIT- IV STEAM TURBINES: Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency

REACTION TURBINE: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency – calculation of blade height.

UNIT – V STEAM CONDENSERS: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirement.

COMPRESSORS – Classification –positive displacement and roto dynamic machinery – Power producing and power was absorbing machines, fan, blower and compressor – positive displacement and dynamic types –reciprocating and rotary types.
Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, undercooling, saving of work, minimum work condition for two stage compression.

UNIT – VI Rotary (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor –mechanical details and principle of working – efficiency considerations.
Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.
Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations – Polytropic efficiency.

Text Books:

1. Thermodynamics and Heat Engines/R.Yadav, Volume -II /Central Publishing House
2. Gas Turbines /V.Ganesan /TMH
3. Heat Engineering /V.P Vasandani and D.S Kumar/Metropolitan Book Company, New Delhi

References:

1. Gas Turbines and Propulsive Systems /P.Khajuria & S.P.Dubey /Dhanpatrai
2. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman
3. Thermal Engineering-R.S Khurmi, &J S Gupta/S.Chand.
4. Thermal Engineering-P.L.Bellaney/ Khanna publishers.
5. Thermal Engineering-M.L.Marthur & Mehta/Jain bros. Publishers
6. Thermal Engineering / RK Rajput/ Lakshmi Publications

Course Code	Design of Machine Members -I	L	T	P	C
18ME4T6	Maximum expected contact hours : **70** Prerequisites : **Mechanics of Solids**	4	1	--	4

PURPOSE: To study the basic design principles and apply the principles to the design of various elements encountered in Mechanical machines and structures.	
INSTRUCTIONAL COURSE OBJECTIVES	
1	Determine the strength of the components.
2	Determine the failure conditions and apply them to real life problems
3	Design simple joints, fasteners levers and springs
4	To understand the various standards and methods of standardisation..
COURSE OUTCOMES	
1	Student will be able to Analyze and select machine elements/components.
2	Student should Know the applications of the various elements, materials used to make them, and methods used
3	Student should Integrate various machine elements and components into the design of a machine or mechanical system through a design project

UNIT-IP

DESIGN FOR STATIC STRENGTH: Basic Procedure of Machine Design, Classifications of Machine design, Factors to be considered in Machine Design, Preferred numbers and significance. Simple Stresses - Combined stresses - Torsion and bending stresses - stress strain relations, Theories of elastic failure – Maximum Principle stress theory, maximum shear stress theory, Distortion energy theory.

UNIT-II

DESIGN FOR FATIGUE STRENGTH: Fluctuating Stresses, Fatigue Failure, Fatigue strength and endurance limit, Endurance limit - Approximate estimation, Stress concentration – theoretical stress concentration factor – Reduction of Stress Concentration, Fatigue stress concentrations factor, Design for fluctuating stresses – Gerber Method, Goodman Method, Soderberg Method. .

UNIT-III

RIVETED JOINTS: Types of riveted joints, Types of Failure, efficiency of riveted joint, Design of Joints for boiler Shell, eccentrically loaded riveted joints.

WELDED JOINTS: Types of welded joints, Strength of Parallel Fillet welds, Strength of Transverse Fillet welds, Axially Loaded Unsymmetrical welded Joints, eccentrically loaded welded joints

UNIT-IV

BOLTED JOINTS: Load on bolt due to initial tightening, external loading, combined loading, Eccentrically loaded bolted joints in shear, Eccentric load perpendicular to axis of bolt

KEYS: Design of keys-stresses in keys

COTTER JOINTS: Types of cotter joints, Design of Socket and Spigot Joint, Design of Sleeve and Cotter Joint, Design of Gib and Cotter Joint, knuckle joint

UNIT-V

SHAFT COUPLING: Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).

UNIT-VI

SPRINGS: Types of springs, Terminology of Helical Springs, Styles of End, Stress and Deflection Equations, Series and parallel Connections, Design of Helical springs, Design against Fluctuating load Leaf springs, Design of Leaf spring, nipping of Leaf Spring

Text Books:

1. Design of Machine Elements, (3rd Edition) by V.B. Bhandari, Tata McGraw Hill Publishers, New Delhi, 2014.

2. Machine Design an Integrated Approach, (5th Edition) Robert L. Norton, Pearson Education Limited, New Delhi, 2013

Reference books:

1. A Textbook of Machine Design (SI Units) (12th Edition) by P. C. Sharma, Dr. D. K. Aggarwal, S. K. Kataria & Sons, New Delhi, 2012.

2. Mechanical Engineering Design, (8th Edition) by Joseph Shigley, Charles R Mischke, Tata McGraw Hill

Publishers, New Delhi, 2008.
3. Design of Machine Elements, by C. S. Sharma, Kamlesh Purohit, Prentice Hall of India Private Limited (PHI), New Delhi, 2009.
4. A Textbook of Machine Design by R S Khurmi, J K Guptha, S Chand & Company Ltd., New Delhi., (25th Edition), 2005.
5. Design of Machine Elements, (2ndEdition) by P. Kannaiah, Scitech Publications India Private Limited, Chennai, 2009.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

1. Design data hand book by K Mahadevan & K Balaveera Reddy, (4th Edition), CBS Publishers, 2013. 2. Design Data Hand Book by S. Md. Jalaluddin, First Edition, Anuradha Publications, Chennai, 2009.

Course Code	MANUFACTURING PROCESS LAB	L	T	P	C
18ME4L1	Maximum expected contact hours :32 Prerequisites: Engineering Workshop	-	-	3	1

PURPOSE: The objectives of the course are to provide hands-on laboratory experience in the area ofproduction, provide basic knowledge about casting and tools used in casting; get familiarized withwelding equipment and various welding processes; acquire practical knowledge in mechanical pressworking and get equip with moulding processes.

	INSTRUCTIONAL COURSE OBJECTIVES
1	To study the various process of manufacturing or production
2	To impart hands-on practical exposure on manufacturing processes and equipment.
3	To aware the various process of casting and its importance
4	To know the working process of TIG/MIG Welding, Resistance Spot Welding, Brazing and soldering.
5	To study the process of making plastics layouts
	COURSE OUTCOMES
1	Design and develop a product using various metal casting methods
2	Fabricate machine components with suitable welding technique.
3	Choose a suitable mechanical press working process to obtain the required shape of metal.
4	Manufacture a plastic component using various plastic processing techniques.
5	Determine the various types of dies like Blanking & Piercing operations and study of simple, compound and progressive dies.

I. METAL CASTING:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - for strength and permeability
3. Mould preparation, Melting and Casting

II WELDING:

1. Gas welding
2. Gas cutting
3. Manual metal arc welding - Lap & Butt Joints
4. TIG/MIG Welding
5. Resistance Spot Welding
6. Brazing and soldering

III METAL FORMING AND POWDER METALLURGY:

1. Blanking & Piercing operations and study of simple, compound and progressive dies.
2. Deep drawing and extrusion operations.
3. Bending and other operations
4. Basic powder compaction and sintering

IV PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

Course Code	FLUID MECHANICS & HYDRAULIC MACHINES LAB	L	T	P	C
18ME4L2	Maximum expected contact hours :32 Prerequisites: Knowledge of Pumps & Flows	--	--	3	1

PURPOSE:	
INSTRUCTIONAL COURSE OBJECTIVES	
1	To study the process of Pelton, Kaplan, and Francis turbines
2	To know the various process of pumps and its efficiencies
3	To study the calibration process of Venturimeter and Orifice Meter
4	To know the and evaluation process of various friction losses
5	To aware the various efficiencies calculated and working procedures for industrial scenario
COURSE OUTCOMES	
1	Tuning flow discharge measuring devices used in pipes channels and tanks.
2	Compute flow equations to solve control volume analysis problems in fluid mechanics.
3	Determine the laminar and turbulent boundary layer fundamentals in fluid flow problems
4	Develop capability to apply conservation principles to hydraulic machines
5	Determine the flows of different types of pumps and its discharge.

1) Impact of jets on Vanes.
2) Performance Test on Pelton Wheel.
3) Performance Test on Francis Turbine.
4) Performance Test on Kaplan Turbine.
5) Performance Test on Single Stage Centrifugal Pump.
6) Performance Test on Multi Stage Centrifugal Pump.
7) Performance Test on Reciprocating Pump.
8) Calibration of Venturimeter.
9) Calibration of Orifice meter.
10) Determination of friction factor for a given pipe line.
11) Determination of loss of head due to sudden contraction in a pipeline.
12) Turbine flow meter.

Course Code	I.C.ENGINES & GAS TURBINES	L	T	P	C
18ME5T1	Maximum expected contact hours : **70**	**4**	**--**	**--**	**3**
	Prerequisites : Thermodynamics				

PURPOSE: To understand the operation, combustion, performance and emissions of internal combustion engines and Gas turbines

INSTRUCTIONAL COURSE OBJECTIVES	
1	To make the student learn and understand the reasons and affects of various losses that occur in the actual engine operation
2	To familiarize the student with the various engine systems along with their function and necessity
3	To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to find the several engine operating parameters that affect the smooth engine operation.
4	To make the student learn to perform testing on S.I and C.I Engines for the calculations of performance and emission parameters
COURSE OUTCOMES	
1	After undergoing this course the student is expected to understand the working of different I.C.Engines and also should be able to analyze and evaluate the performance of individual components..
2	The student also should be in a position to understand basic principles of Gas turbines, Jet propulsion and rocket engineering

UNIT-I

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines

UNIT-II

I. C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of supercharging and turbo charging

UNIT-III

Combustion in S.I. Engines : Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types.

Combustion in C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating**.**

UNIT-IV

Measurement, Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

UNIT-V

GAS TURBINES: Simple gas turbine plant – ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –closed and semi-closed cycles – merits and demerits, types of combustion chambers

UNIT-VI

JET PROPULSION : Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on t-s diagram - thrust, thrust power and propulsion efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation, thrust augmentation – methods.

Rockets : Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines**.**

Text Books:

1. Thermodynamics and Heat Engines/R.Yadav, Volume -II /Central Publishing House
2. Gas Turbines /V.Ganesan /TMH
3. Heat Engineering /V.P Vasandani and D.S Kumar/Metropolitan Book Company, New Delhi

References:

1. Gas Turbines and Propulsive Systems /P.Khajuria & S.P.Dubey /Dhanpatrai
2. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman
3. Thermal Engineering-R.S Khurmi, &J S Gupta/S.Chand.
4. Thermal Engineering-P.L.Bellaney/ Khanna publishers.
5. Thermal Engineering-M.L.Marthur & Mehta/Jain bros. Publishers
6. Thermal Engineering / RK Rajput/ Lakshmi Publications

Course Code	THEORY OF MACHINES -II	L	T	P	C
18ME5T2	Maximum expected contact hours : **73** Prerequisites : **Kinematics of Machinery**	3	1	--	3

PURPOSE: To expose the students to learn the fundamentals of various laws governing rigid bodies and its motions	
INSTRUCTIONAL COURSE OBJECTIVES	
1	Develop understanding of dynamic analysis like gyroscopic forces and moments, friction of fixed axis rotation of rigid bodies.
2	Determine the dynamic behavior principles and operations of clutches, breaks, flywheels and governers
3	Relate static and dynamic balancing analysis as applied to machines
4	To understand the various standards and methods of standardisation..
COURSE OUTCOMES	
1	At the end of course the students will be able to Apply friction principles to clutches& brakes
2	Determine the gyroscopic effects on rotating elements and compute inertia forces in reciprocating parts
3	Describe the operation and analysis of flywheel and governors
4	Calculate static and dynamic balancing for rotating and reciprocating machinery
5	Analyze the natural frequencies & vibration analysis for single degree of freedom system

UNIT-I

PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships, static and dynamic force analysis of planar mechanisms

UNIT-II

FRICTION: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, film lubrication.

CLUTCHES: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch

UNIT-III

TURNING MOMENT DIAGRAMS: Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.

UNIT-IV

GOVERNERS: Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung with auxiliary springs. sensitiveness, isochronism and hunting.

UNIT-V

BALANCING OF ROTATING MASSES: Introduction, Static balancing, Dynamic balancing, Balancing of single unbalanced rotating mass, Balancing of Several Masses in the same planes, Balancing of Several Masses in Different planes**.**

BALANCING OF RECIPROCATING MASSES Introduction to Primary and Secondary balancing. Balancing of Multi cylinder in-line and radial engines

UNIT-VI

FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, Definitions, types of vibrations and causes of vibrations, Basic features of Vibrating system, Degree of freedom, D Alembert's Principle, Energy method, Un damped free longitudinal, transverse and torsional vibrations of single degree of freedom systems, equivalent stiffness

Text Books:

1. Theory of Machines, (3rd Edition) by S.S.Rattan ,Tata Mc.Graw Hill, New Delhi, 2012
2. Mechanism and machine theory /Ashok G. Ambedkar/PHI Publications

Reference Books:

1. Theory of Machines: Kinematics & Dynamics, by P.L. Ballaney, I.K.International Pvt. Ltd., New Delhi,2010
2. Theory of Machines, by B.V.R. Guptha, Khanna Publications, New Delhi,11th Edition,1980
3. Theory of Machines, (5th Edition) by R.K.Bansal, Laxmi Publications(p) ltd. New Delhi, ,2010.

Course Code	Manufacturing Technology	L	T	P	C
18ME5T3	Maximum expected contact hours : **70**	4	--	--	3
	Prerequisites : Knowledge in Engg. workshop,EDP,ME-1.				

PURPOSE: To make the students aware of different manufacturing processes like casting, metal forming, metal cutting and gear manufacturing

	INSTRUCTIONAL COURSE OBJECTIVES
1	Provide the basic concepts in mechanics of metal cutting, chip formation, various tool materials and tool life.
2	Impart the concept of types of lathe, various operations that can be performed in various lathes, various mechanisms adopted.
3	Instruct the working principle, operations performed, work, tool holding devices and different attachments in milling and drilling machines
4	Educate the basic fundamentals of reciprocating machine tools shaper, slotter and planning machines
5	Acquaint with the fundamentals of finishing process, super finishing process and their associated machine tools
	COURSE OUTCOMES
1	students will be able to Demonstrate fundamentals of metal removal processes
2	students will be able to Illustrate working principle, mechanism and various operations performed on lathe
3	students will be able to Explain the mechanisms of shaper, planner and slotter and various machining operations Performed
4	students will be able to Describe drilling and grinding machines, various operations and Nomenclature

UNIT-I

BASICS OF METAL CUTTING: Elementary treatment of metal cutting theory – elements of cutting process – geometry of single point cutting tools, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting – Merchant's force diagram, cutting forces, Tool wear, tool life, machinability, cutting fluids, tool materials**.**

UNIT-II

LATHE: Engine lathe – principle of working, specification of lathe – types of lathe – work, tool holding devices for lathes, accessories and attachments- Taper turning, Thread cutting – lathe operations, Capstan and Turret lathes – collet chucks – other work holding, tool holding devices –tool layout. Principal features of automatic lathes – classification – single spindle and multi-spindle automatic lathes.

UNIT-III

SHAPING, SLOTTING AND PLANNING MACHINES: Principles of working – principal parts, specifications, operations performed, machining time calculations.

DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed tool holding devices – twist drill – Boring Machines – fine Boring Machines – jig boring machine, deep hole Drilling Machine.

UNIT-IV

MILLING MACHINES: Principles of working – specifications – classification of Milling Machines – principal features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters, geometry of milling cutters – methods of indexing, accessories to milling machines.

UNIT-V

FINISHING PROCESSES: Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding

UNIT-VI

JIGS & FIXTURES**: Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location and clamping, types of clamping & work holding devices, typical examples of jigs andfixtures.**

CNC MACHINE TOOLS: CNC Machines, working principle, classification, constructional features of CNC machines, CNC controller, types of motion controls in CNC machines, applications of CNC machines.

Text Books:

1. Manufacturing technology - Metal cutting and Machine tools, 2nd edition by P.N Rao, TMH publications, 2000.
2. Machining and machine tools, by A.B. Chattopadhyay, wiley india pvt. Limited, 2011

Reference Books:

1. Metal cutting Principles, by M.C. Shaw, 3rd ed., Oxford, 1957.
2. Production Technology, by HMT, (Hindustan Machine Tools), TMH publications 2001.
3. Workshop Technology Vol II, (10th edition), by B.S.Raghu Vamshi, Dhanpat Rai & co (p) Ltd., 2009. 4. Manufacturing Science, by Amitabha Ghosh and Asok Kumar Mallik, East West Press, 2nd Edition, 2010.

Course Code	Design of Machine Members -II	L	T	P	C
18ME5T4	Maximum expected contact hours : **70**	4	1	--	4
	Prerequisites : **Design of machine Members-I, Kinematics of Machinery**				

PURPOSE: To study the design of various mechanical transmission systems.	
INSTRUCTIONAL COURSE OBJECTIVES	
1	This course gives the insight of slider and roller bearings and the life prediction.
2	Learn to design I.C engine parts
3	Design the mechanical systems for power transmission elements such as gears,belts,ropes,chains, keys and levers
COURSE OUTCOMES	
1	The student will able to select the suitable bearing based on the application of the loads and predict the life of the bearing
2	Design power transmission elements such as gears, belts, chains, pulleys, ropes, levers and power screw
3	Design of IC Engines parts

UNIT-I

BEARINGS:

Classification of bearings- applications, types of journal bearings – lubrication – bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.

UNIT-II

I.C ENGINE PARTS:

Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends – cranks and crank shafts, strength and proportions of over hung and center cranks – crank pins, crank shafts.

Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners,

UNIT-III

DESIGN OF CURVED BEAMS: introduction, stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and t-section, design of crane hooks, c –clamps

UNIT-IV

POWER TRANSMISSIONS SYSTEMS, PULLEYS: Transmission of power by belt and rope drives , transmission efficiencies, belts – flat and v types – ropes - pulleys for belt and rope drives, materials, chain drives

UNIT-V

DESIGN OF POWER SCREWS: Design of screw, square ACME, buttress screws, design of nut, compound screw, differential screw, ball screw- possible failures

WIRE ROPES: Construction, Designation, Stresses in wire ropes, rope sheaves and drums**.**

UNIT-VI

SPUR GEARS: Classification of gears, Terminology of spur gear, Force analysis, Gear tooth failures, Beam Strength of gear teeth, Dynamic tooth Load, wear tooth load, Lewis Equation.

HELICAL GEARS: Terminology of helical gears, force analysis, Beam Strength of helical gears, effective load on gear tooth, wear strength of helical gears, Lewis Equation**.**

Text Books:

1. Design of Machine Elements, (3rd Edition) by V.B. Bhandari, Tata McGraw Hill Publishers, New Delhi, 2014.

2. Machine Design an Integrated Approach, (5th Edition) Robert L. Norton, Pearson Education Limited, New Delhi, 2013

Reference books:

1. A Textbook of Machine Design (SI Units) (12th Edition) by P. C. Sharma, Dr. D. K. Aggarwal, S. K. Kataria & Sons, New Delhi, 2012.

2. Mechanical Engineering Design, (8th Edition) by Joseph Shigley, Charles R Mischke, Tata McGraw Hill Publishers, New Delhi, 2008.

3. Design of Machine Elements, by C. S. Sharma, Kamlesh Purohit, Prentice Hall of India Private Limited (PHI), New Delhi, 2009.

4. A Textbook of Machine Design by R S Khurmi, J K Guptha, S Chand & Company Ltd., New Delhi., (25th

Edition), 2005.
5. Design of Machine Elements, (2ndEdition) by P. Kannaiah, Scitech Publications India Private Limited, Chennai, 2009.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

1. Design data hand book by K Mahadevan & K Balaveera Reddy, (4th Edition), CBS Publishers, 2013. 2. Design Data Hand Book by S. Md. Jalaluddin, First Edition, Anuradha Publications, Chennai, 2009.

Course Code	INDUSTRIAL ENGINEERING MANAGEMENT	L	T	P	C
18ME5T5A	Maximum expected contact hours : **64** Prerequisites: Industrial Engineering	4	0	0	3

PURPOSE: The main objective of this course is to introduce the concepts of risk management, financial planning and entrepreneurship	
INSTRUCTIONAL COURSE OBJECTIVES	
1	The management, organization methods as practiced in industry and the Human Resource Management and labor laws.
2	The financial analysis, learning from balance sheet
3	Thoroughly types of production systems and quality control
4	The concepts of material management and marketing techniques
5	The techniques application to industry for better management of various resources.
COURSE OUTCOMES	
1	Summarize the concepts of general management, financial management, human resources, production management, and marketing management. .
2	Illustrate the application with to identify solutions to industry problems.
3	Identify the optimum solutions with system approach to both industry and service sector.
4	Judge the advanced software tools for decision making with available sources for cost reduction and profit maximization with society concern.
5	Develop a team and play a key role in decision making with interpretation skills for all round development of organization

UNIT-I Defining Operations Management, functions and its historical evolution.
Forecasting: Approaches to Forecasting: Qualitative approach - Judgmental methods, quantitative methods- time series, regression.
AGGREGATE PLANNING: purpose, procedure and techniques

UNIT-II Production Management: Types of production systems, Product analysis, brief treatment of functions of production Planning and Control, Value analysis
Scheduling: Introduction, concept of batch production systems, Loading, Sequencing, and scheduling the n jobs on a single machine, two machines, three machines, m-machines. Problem solving.

UNIT –III INVENTORY CONTROL : Introduction, models, Inventory costs, Basic models EOQ and EBQ with-out shortages, Quantity discounts, Selective control -- ABC analysis, Problem solving
Quality Control: Inspection and types, SQC - Control charts for attributes and variables, construction and application – Acceptance sampling, sampling plans, Construction of O.C. curve. Problem solving.
UNIT – IV General Management: General Management, Principles of Scientific Management; Brieftreatment of Managerial Functions. Modern Management concept.
Personnel Management: The Personnel Function, Staff Role in Person Department, Personnel Functions Job Design, Job Information,

UNIT – V Financial Management: Concept of Interest, Compound Interest, **Economic Evaluation of Alternatives:** The Annual Equivalent Method, Present Worth Method, Future Worth Method. Depreciation – Purpose, Types of Depreciation; Common Methods of Depreciation; The Straight-Line Method, Declining Balance Method, The Sum of the years Digits Method, A Brief Treatment of Balance Sheet, Ratio Analysis.Introduction to JIT / Lean Manufacturing, Six Sigma Quality Concept, Supply Chain Management,Business Process Reengineering, Concurrent Engineering, Enterprise Resource Planning.

Text Books

1) Management By Koontz & Weirch
2) Engineering Economy By E. Paul Degarmo,John R.Chandra,William G.Sullivan.
3) Operations Management by Adam & Ebert.

Reference Books :

1) Production & Operations Management By Panner Selvam.
2) Industrial Organization & Engineering Economics By Banga & Sharma
3) Operations Management by Mahadevan.

Course Code	THEORY OF MACHINES LAB	L	T	P	C
18ME5L1	Maximum expected contact hours : 32 Prerequisites : Dynamics of machinery		--	3	1
PURPOSE: To expose the students to learn the fundamentals of various laws governing rigid bodies and its motions					
INSTRUCTIONAL COURSE OBJECTIVES					
1	Determine the vibration parameters of a vibrating system				
2	Predict the radius of gyration and moment of inertia of vibrating system				
3	Verify the static and dynamic balancing				
4	Study the effect of gyroscopic couple and operations of robotic arm				
COURSE OUTCOMES					
1	student will be able to Evaluate the natural frequencies in different vibrating systems and effect of gyroscopic couple				
2	student will be able to Compute the radius of gyration & Moment of Inertia of oscillating part in vibration system				
3	student will be able to Apply the concepts of damping to determine damping coefficient				
4	student will be able to Measure the amplitude of vibration in damped and un damped vibrating system				
5	student will be able to Verify the static balancing and dynamic balancing 6. Implement the operations to manipulate the robot arm in industries				

LIST OF EXPERIMENTS

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage , velocity ratio and efficiency
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears

Course Code	MANUFACTURING TECHNOLOGY LAB	L	T	P	C
18ME5L2	Maximum expected contact hours :		--	3	1
	Prerequisites : Manufacturing Technology				
PURPOSE: To familiarize the different cutting techniques in different machines					
INSTRUCTIONAL COURSE OBJECTIVES					
1	Familiarize different machine tools used in production floor.				
2	Impart hands on experience on lathe, drilling, shaping, milling, slotting, Grinding, Planning and tool and cutter grinding machines.				
COURSE OUTCOMES					
1	students will be able to Perform step, taper turning, threading, knurling and Form turning				
2	students will be able to Perform Drilling & Tapping operations on given work piece.				
3	students will be able to Produce plain or stepped surface using shaper, planner and surface grinder				
4	students will be able to Fabricate keyway slot using milling machine and slotter.				
5	students will be able to Prepare different cutting tool angles using Tool and cutter grinder.				

LIST OF EXPERIMENTS

Any 12 Experiments of the following

Lathes

1. Plain Turning
2. Step turning
3. Taper turning by swivelling compound rest
4. Taper turning by taper turning attachment
5. Threading
6. Knurling
7. Form Turning

Non-Lathes

1. Drilling and tapping on Square block
2. Shaping a stepped surface
3. Slotting a Rectangular slot
4. Milling a Keyway
5. Surface grinding of Rectangular block
6. Grinding of single point cutting tool angles.
7. Planing a stepped surface

Course Code	THERMAL ENGINEERING LAB	L	T	P	C
18ME5L3	Maximum expected contact hours : 32 Prerequisites : IC Engines and Gas Turbines		--	3	1

PURPOSE: To learn about the how to calculate various performance parameters	
INSTRUCTIONAL COURSE OBJECTIVES	
1	Determine the calorific value of different types of solid, liquid and gaseous fuels by using bomb calorimeter and Junker's gas calorimeter and to estimate quality of the fuel using carbon residue tester..
2	Evaluate the performance of various types of petrol, diesel engines and reciprocating air compressor, study of boilers
COURSE OUTCOMES	
1	Test the performance of different types of petrol engine and diesel.
2	Assess the performance of reciprocating air compressor, boilers, disassembly and assembly of engine.
3	Calculate calorific values among different types of solid, liquid and gaseous fuels
4	Measure the quality of the fuel by estimating the carbon residue of the fuel

LIST OF EXPERIMENTS

Any 12 Experiments of the following

I.C. Engines Lab

1. I.C. Engines valve/ port time diagram
2. I.C. Engines Performance Test (4-stroke Diesel Engines)
3. I.C. Engines Performance Test on 2-stroke petrol engine
4. Evaluation of Engine friction by conducting Morse test on 4-stroke Multi cylinder petrol Engine
5. Retardation test on diesel engine
6. I.C. Engines Heat Balance
7. I.C. Engines Air/Fuel Ratio and Volumetric Efficiency
8. 8 .Performance test on computer based 4 stroke multi cylinder petrol engine
9. Performance Test on Reciprocating Air-Compressor unit
10. Study of Boilers
11. Disassembly/Assembly of Engines.

Fuels Lab :

1. Junker's gas calorimeter
2. Bomb calorimeter
3. Canradson's carbon residue tester

Course Code	INSTRUMENTATION & CONTROL SYSTEMS	L	T	P	C
18ME6T1	Maximum expected contact hours : **64** Prerequisites :	4	--	--	3

PURPOSE: Measuring of various parameters using different Measuring Equipments.

INSTRUCTIONAL COURSE OBJECTIVES

1	The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices that are in use to measure the important physical variables of various mechatronic systems.

COURSE OUTCOMES

1	After undergoing the course the student can select appropriate device for the measurement of parameters like temperature, pressure, speed, stress, humidity, flow velocity etc., and justify its use through characteristics and performance.

UNIT – I

Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. dynamic performance characteristics – sources of error, classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

UNIT – II

MEASUREMENT OF TEMPERATURE: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermister – thermocouple – pyrometers – temperature indicators.

MEASUREMENT OF PRESSURE: Units – classification – different principles used. manometers, piston, bourdon pressure gauges, bellows – diaphragm gauges. Low pressure measurement – thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT – III

MEASUREMENT OF LEVEL: Direct method – indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators.

FLOW MEASUREMENT: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).

MEASUREMENT OF SPEED: Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer

Measurement of Acceleration and Vibration: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.

UNIT – IV

STRESS STRAIN : MEASUREMENTS : Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.

UNIT – V

MEASUREMENT OF HUMIDITY – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter.

MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, torsion meters, dynamometers.

UNIT – VI

ELEMENTS OF CONTROL SYSTEMS: Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.

Text Books:

1. Measurement Systems: Applications & design / D.S Kumar/
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, Pearson

References:

1. Measurement systems: Application and design/Doeblin Earnest.
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra & K.K.Choudhary/TMH

Course Code	METROLOGY	L	T	P	C
18ME6T2	Maximum expected contact hours : **64** Prerequisites :	4	--	--	3

PURPOSE: Measuring of various parameters (length, Diameter etc) ,using different Measuring Devices.	
INSTRUCTIONAL COURSE OBJECTIVES	
1	Inspection of engineering parts with various precision instruments
2	Design of part, tolerances and fits
3	Principles of measuring instruments and gauges and their uses
4	Evaluation and inspection of surface roughness
5	Inspection of spur gear and thread elements
6	Machine tool testing to evaluate machine tool quality
COURSE OUTCOMES	
1	Students will be able to design tolerances and fits for selected product quality. They can choose appropriate method and instruments for inspection of various gear elements and thread elements.
2	Students can understand the standards of length, angles; they can understand the evaluation of surface finish and measure the parts with various comparators. The quality of the machine tool with alignment test can also be evaluated by them.

UNIT-I

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, fits – Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability, determistic & statistical tolerances, selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.

UNIT-II

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip gauges, dial indicators, micrometers.

MEASUREMENT OF ANGLES AND TAPERS:

Different methods – bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table, rollers and spheres used to measure angles and tapers.

LIMIT GAUGES:

Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges.

UNIT-III

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope and uses - autocollimators, optical projector, optical flats and their uses.

INTERFEROMETRY:

Interference of light, Michelson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.

UNIT-IV

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.

COMPARATORS: Types - mechanical, optical , electrical and electronic, pneumatic comparators and their use.

UNIT – V

GEAR MEASUREMENT: Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier & flange micro meter, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester, involute profile checking.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads- concept of virtual effective diameter, measurement of effective diameter, angle of thread and thread pitch, and profile thread gauges.

UNIT – VI

FLATNESS MEASUREMENT:

Measurement of flatness of surfaces- instruments used- straight edges- surface plates – auto collimator.

MACHINE TOOL ALIGNMENT TESTS: Principles of machine tool alignment testing on lathe, drilling and milling machines.

Text Books:

1. Dimensional Metrology/Connie Dotson/Cengage Learning
2. Engineering Metrology / R.K.Jain / Khanna Publishers

References:

1. Engineering Metrology / Mahajan / Dhanpat Rai Publishers
2. Engineering Metrology / I.C.Gupta / Dhanpat Rai Publishers
3. Precision Engineering in Manufacturing / R.L.Murthy / New Age
4. Engineering Metrology and Measurements / NV Raghavendra, L Krishna murthy/ Oxford publishers.
5. Engineering Metrology / KL Narayana/Scitech publishers

Course Code	OPERATION RESEARCH	L	T	P	C
18ME6T3	Maximum expected contact hours : **75** Prerequisites :	**3**	**1**	**--**	**3**

PURPOSE: To familiarize with the components of computer aided manufacturing and production planning.	
INSTRUCTIONAL COURSE OBJECTIVES	
1	Obtain mathematical skills for solving engineering and economic problems; determine optimal solutions to a variety of situations, and present managerial recommendations based on optimal solutions.
2	Acquire the skills for solving real time problems, using numerical techniques.
COURSE OUTCOMES	
1	Upon completion of this course the student will be able to Formulate practical situations by using linear programming and solving problems such as transportation, allocation and sequencing of jobs..
2	student will be able to Establish decisions about replacement of items that deteriorate with time and solve game theory problems
3	student will be able to Assess the utilization of facility by applying waiting line theory and solve inventory problems
4	student will be able to Solve practical problems by using integer, Dynamic programming and simulate real time problems

UNIT-I

INTRODUCTION TO 'OR'– Definition, Characteristics and Phases of OR, Operation Research models, applications.

LINEAR PROGRAMMING: Linear Programming Problem Formulation, Graphical solution Simplex method, artificial variables techniques-Two–phase method, Big-M method, Duality Principle**.**

UNIT-II

TRANSPORTATION PROBLEM: Formulation, Optimal solution, U-V method, unbalanced transportation problems, Degeneracy.

ASSIGNMENT PROBLEM: Formulation, Optimal solution, Variants of Assignment Problem-Traveling Salesman problem.

UNIT-III

THEORY OF GAMES: Introduction – mini, max (max, mini) – criterion and optimal strategy-- to solve the rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games.

REPLACEMENT : Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT-IV

WAITING LINES : Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population **–**

SIMULATION Definition – types of simulation models – phases of simulation – application of simulation – inventory and queuing problems – merits and demerits -- simulation languages.

UNIT-V

PROJECT MANAGEMENT BY PERT/CPM: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rules, Critical path method (CPM)- floats, critical path, project duration,

PERT : Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion.

UNIT-VI

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem

Text Books:

1. Operations Research, by S.D.Sharma, Kedarnath & Ramnath publications (15th edition),2013.
2. Introduction to Operations Research, by Taha, Pearson Education,New Delhi, (8th edition), 2008.

Reference Books:

1. Operations Research, (4th edition) by A.M .Natarajan, P. Balasubramani, ATamilarasi, Pearson Education, New Delhi, 2009.
2. Operations Research, (2nd edition) by R.Pannerselvam, 2009,PHI Publications, Noida
3. Operations Research, (2nd edition) by Wagner, 2007, PHI Publications, Noida
4. Operation Research, (4th edition) by J.K.Sharma, 2009, MacMilan publishers, india Ltd. New Delhi..

Course Code	REFRIGERATION & AIR CONDITIONING (Refrigeration and Psychometric tables and charts allowed)	L	T	P	C
18ME6T4	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : Thermodynamics				

PURPOSE:

INSTRUCTIONAL COURSE OBJECTIVES	
1	The course is to understand the basic cycles of various refrigerating systems, their performance evaluation along with details of system components and refrigerant properties.
2	The course is also aimed at imparting knowledge of psychrometric properties, processes which are used in air-conditioning systems for comfort and industrial applications.
COURSE OUTCOMES	
1	After undergoing the course the student should be in a position to analyze various refrigerating cycles and evaluate their performance.
2	The student also should be able to perform cooling load calculations and select the appropriate process and equipment for the required comfort and industrial air-conditioning

UNIT – I

INTRODUCTION TO REFRIGERATION: Necessity and applications – unit of refrigeration and C.O.P. –Mechanical refrigeration – types of ideal cycles of refrigeration. air refrigeration: bell coleman cycle - open and dense air systems – refrigeration systems used in air crafts and problems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION: Working principle and essential components of the plant –simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

UNIT III

REFRIGERANTS – Desirable properties – classification - refrigerants used – nomenclature – ozone depletion –global warming

VCR SYSTEM COMPONENTS: Compressors – general classification – comparison – advantages and disadvantages. condensers – classification – working principles evaporators – classification – working principles expansion devices – types – working principles

UNIT IV

VAPOR ABSORPTION SYSTEM: Calculation of maximum COP – description and working of NH3 – water system and Li Br –water (Two shell & Four shell) System, principle of operation three fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM: Working Principle and basic components. principle and operation of (i) thermoelectric refrigerator (ii) vortex tube.

UNIT – V

INTRODUCTION TO AIR CONDITIONING: Psychometric properties & processes – characterization of sensible and latent heat loads — need for ventilation, consideration of infiltration – load concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature. Requirements of human comfort and concept of effective temperature- comfort chart –comfort air conditioning – requirements of industrial air conditioning, air conditioning load calculations.

UNIT – VI

AIR CONDITIONING SYSTEMS: Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. heat pump – heat sources – different heat pump circuits.

Text Books:

1. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar / Dhanpatrai
2. Refrigeration and Air Conditioning / CP Arora / TMH.

References:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age.
2. Principles of Refrigeration /Dossat / Pearson Education.

Course Code	GREEN ENGINEERING SYSTEMS (ELECTIVE IV)	L	T	P	C
18ME6T5A	Maximum expected contact hours : 64	3	1	--	3
	Prerequisites : Thermodynamics				

PURPOSE:

INSTRUCTIONAL COURSE OBJECTIVES	
1	The course aims to highlight the significance of alternative sources of energy, green energy systems and processes and provides the theory and working principles of probable sources of renewable and green energy systems that are environmental friendly.
COURSE OUTCOMES	
1	The student shall understand the principles and working of solar, wind, biomass, geo thermal, ocean energies and green energy systems and appreciate their significance in view of their importance in the current scenario and their potential future applications.

UNIT-I

INTRODUCTION:

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells, I-V characteristics

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT – II

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

UNIT – III

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India.

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT –IV

ENERGY EFFICIENT SYSTEMS:

ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.

MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps**.**

UNIT-V

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

UNIT – VI

GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

Text Books:

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/ TMH
2. Non-Conventional Energy Resources/ Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems, Edited / J. Paulo Davim/Springer 2013

References:

1. Alternative Building Materials and Technologies / K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering / D.Yogi Goswami, Frank Krieth & John F Kreider / Taylor & Francis
3. Non-Conventional Energy / Ashok V Desai /New Age International (P) Ltd
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa
5. Non conventional Energy Source/ G.D Roy/Standard Publishers
6. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd
7. Fuel Cell Technology –Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd.

Course Code	HEAT TRANSFER (Heat transfer data book allowed)	L	T	P	C
18ME6T6	Maximum expected contact hours : **70**	**4**	**--**	**--**	**3**
	Prerequisites : **Applied Thermodynamics**				

PURPOSE: This course provides the knowledge to understand the various modes of heat transfer and the basic concept of mass transfer.

INSTRUCTIONAL COURSE OBJECTIVES

1	This course is intended to impart knowledge of principles of heat transfer and analyze the heat exchange process in various modes for the evaluation of rate of heat transfer and the temperature distribution in different configurations.

COURSE OUTCOMES

1	The student after undergoing this course is expected to know the principles of heat transfer and be able to apply to practical situations where in heat exchange takes place through various modes of heat transfer including phase change.

UNIT-I

INTRODUCTION: Modes and mechanisms of heat transfer – basic laws of heat transfer –General discussion about applications of heat transfer.

CONDUCTION HEAT TRANSFER: Fourier rate equation – general heat conduction equation in cartesian, cylindrical and Spherical coordinates. Steady, unsteady and periodic heat transfer – initial and boundary conditions.

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – critical radius of insulation- Variable thermal conductivity – systems with heat sources or heat generation,

UNIT-II

EXTENDED SURFACE (FINS) HEAT TRANSFER – long fin, fin with insulated tip and short fin, application to error measurement of temperature.

ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER: Systems with negligible internal resistance – significance of biot and fourier numbers - chart solutions of transient conduction systems

UNIT-III

CONVECTIVE HEAT TRANSFER: Classification of convective heat transfer – dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem for forced and free convection, application for developing semi – empirical non- dimensional correlation for convective heat transfer – Significance of nondimensional numbers – concepts of continuity, momentum and Energy Equations

UNIT-IV

FORCED CONVECTION

EXTERNAL FLOWS: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -flat plates and cylinders.

INTERNAL FLOWS: Concepts about hydrodynamic and thermal entry lengths – division of internal flow based on this –use of empirical relations for horizontal pipe flow and annulus flow.

FREE CONVECTION: Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and pipes.

UNIT-V

HEAT TRANSFER WITH PHASE CHANGE

BOILING: Pool boiling – regimes- calculations on nucleate boiling, critical heat flux and film boiling.

CONDENSATION: Film wise and drop wise condensation –Nusselt's theory of condensation on a vertical plate - film condensation on vertical and horizontal cylinders using empirical correlations.

HEAT EXCHANGERS:

Classification of heat exchangers – overall heat transfer coefficient and fouling factor – concepts of LMTD and NTU methods – Problems**.**

UNIT-VI

RADIATION HEAT TRANSFER:

Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

Text Books:

1. Heat Transfer /JP HOLMAN/TMH
2. Heat Transfer /P.K.Nag/ TMH
3. Principles of Heat Transfer /Frank Kreith, RM Manglik & MS Bohn/Cengage learning publishers

Reference books:

1. Heat and Mass Transfer /Arora and Domkundwar/Dhanpatrai & sons
2. Fundamentals of Engg. Heat and Mass Transfer / R.C.Sachdeva / New Age International
3. Heat and Mass Transfer /Cengel/McGraw Hill.
4. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria & Sons
5. A Text book on Heat Transfer-4th Edition/ S.P Sukhatme/Universities Press

Course Code	HEAT TRANSFER LAB	L	T	P	C
18ME6L1	Maximum expected contact hours : **64**	**-**	**-**	**3**	**1**
	Prerequisites : HEAT TRANSFER				

PURPOSE: To knowing about various of modes of heat transfer

INSTRUCTIONAL COURSE OBJECTIVES	
1	The laboratory course is aimed to provide the practical exposure to the students with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for several geometries
COURSE OUTCOMES	
1	The student should be able to evaluate the amount of heat exchange for plane, cylindrical & spherical geometries and should be able to compare the performance of extended surfaces and heat exchangers

1. COP of VCR System with Capillary and thermal expansion valve.
2. Determination of overall heat transfer co-efficient of a composite slab
3. Determination of heat transfer rate through a lagged pipe.
4. Determination of heat transfer rate through a concentric sphere
5. Determination of thermal conductivity of a metal rod.
6. Determination of efficiency of a pin-fin
7. Determination of heat transfer coefficient in natural and forced convection
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzman constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Determination of Thermal conductivity of liquids and gases.
14. Investigation of Lambert’s cosine law.

Course Code	METROLOGY & INSTRUMENTATION LAB	L	T	P	C
18ME6L2	Maximum expected contact hours : **64** Prerequisites :	--	--	3	1

PURPOSE: To measure various parameters using Different measuring Equipments	
INSTRUCTIONAL COURSE OBJECTIVES	
1	The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements.
2	The student can learn the measurements with and calibration of instruments. They also understand the machine tool alignment test.
3	Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.
COURSE OUTCOMES	
1	The student should be able to Measure the Dimensions of the work piece using different measuring Devices.
2	The student should be able to Calibrate various devices using the Instruments.

METROLOGY LAB

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier caliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.
4. Machine tool alignment test on the lathe.
5. Machine tool alignment test on drilling machine.
6. Machine tool alignment test on milling machine.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool makers microscope.
10. Surface roughness measurement with roughness measuring instrument.

INSTRUMENTATION LAB

1. Calibration of pressure gauge.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge.
5. Calibration of thermocouple.
6. Calibration of capacitive transducer.
7. Study and calibration of photo and magnetic speed pickups.
8. Calibration of resistance temperature detector.
9. Study and calibration of a rotameter.
10. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at variousloads.
11. Study and calibration of Mcleod gauge for low pressure.

Note: The students have to conduct at least 8 experiments from each lab

Course Code	FINITE ELEMENT METHODS	L	T	P	C
18ME7T1	Maximum expected contact hours : **64** Prerequisites : **Strength of Materials and Engineering mathematics**	3	1	--	3

PURPOSE: finite Element Analysis enables the user to virtually test and predict the behaviour of mechanical structures in addition to solving complex engineering problems. Stemming from the **Finite Element Method (FEM)**, FEA is a mathematical technique used to simulate almost any given physical phenomenon.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To learn basic principles of finite element analysis procedure
2	To learn the theory and characteristics of finite elements that represent engineering structures.
3	To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.
4	Learn to model complex geometry problems and solution techniques.
COURSE OUTCOMES	
1	Understand the concepts behind variational methods and weighted residual methods in FEM
2	Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparametric elements, and 3-D element.
3	Develop element characteristic equation procedure and generation of global stiffness equation will be applied.
4	Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
5	Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.

UNIT-I Introduction to finite element method, stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational and weighted residual methods, concept of potential energy, one dimensional problems.

UNIT – II Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.

UNIT – III Analysis of Trusses: Finite element modelling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT – IV Finite element modelling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems

UNIT-V Higher order and isoparametric elements: One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements and numerical integration.
UNIT – VI Steady state heat transfer analysis : one dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion.
Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

Text Books:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.

References:

1. Finite Element Method with applications in Engineering / YM Desai, Eldho & Shah/Pearson publishers
2. An introduction to Finite Element Method / JN Reddy / McGraw Hill

3. The Finite Element Method for Engineers – Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith and Ted G. Byrom / John Wiley & sons (ASIA) Pte Ltd.
4. Finite Element Analysis: Theory and Application with Ansys, Saeed Moaveniu, Pearson Education
5. Finite Element Methods / Chen
6. Finite Element Analysis: for students & Practicing Engineers / G.Lakshmi Narasaiah / BSP Books Pvt.Ltd.

Course Code	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
18ME7T2	Maximum expected contact hours : **60**	**4**	**--**	**--**	**3**
	Prerequisites : BASIC MECHANICAL AND ELECTRONICS				

PURPOSE: able to know the importance and various devices of MEMS and their applications.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To learn basics of Micro Electro Mechanical Systems (MEMS).
2	To learn about various sensors and actuators used in MEMS.
3	To learn the principle and various devices of MEMS, Fluidic, bio and chemical systems.
COURSE OUTCOMES	
1	Upon successful completion of this course the student shall be able to know the importance and various devices of MEMS and their applications.

Unit – I : INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

Unit – II : THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

Unit – III: MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

Unit – IV : MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

Unit – V : MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS:RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

Unit – VI : CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

TEXT BOOK

- MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

REFERENCE BOOKS

- Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
- MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
- MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
- Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Course Code	CAD/CAM	L	T	P	C
18ME7T3	Maximum expected contact hours : **64** Prerequisites : **Knowledge in manufacturing technology and computer basics**	4	--	--	3

PURPOSE: CAD/CAM stands for computer-aided design & computer-aided manufacturing. CAD/CAM software is used to design and manufacture prototypes, finished products and production runs.

	INSTRUCTIONAL COURSE OBJECTIVES
1	Understand the basic fundamentals of computer aided design and manufacturing.
2	To learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc.
3	To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication.
4	To learn the part programming, importance of group technology, computer aided process planning, computer aided quality control.
5	To learn the overall configuration and elements of computer integrated manufacturing systems
	COURSE OUTCOMES
1	Describe the mathematical basis in the technique of representation of geometric entities including points, lines, and parametric curves, surfaces and solid, and the technique of transformation of geometric entities using transformation matrix
2	Describe the use of GT and CAPP for the product development
3	Identify the various elements and their activities in the Computer Integrated Manufacturing Systems

UNIT – I Computers in industrial manufacturing, product cycle, CAD / CAM Hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices.

COMPUTER GRAPHICS: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT – II GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modelling.

UNIT – III PART PROGRAMMING FOR NC MACHINES: NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming. Direct Numerical Control, Adaptive Control.

UNIT – IV GROUP TECHNOLOGY: Part family, coding and classification, production flow analysis, types and advantages. Computer aided processes planning – importance, types. FMS-Introduction, Equipment, Tool management systems, Layouts, FMS Control.

UNIT – V COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, computer aided testing, integration of CAQC with CAD/CAM.

UNIT – VI COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits.

Text Books:

1. CAD / CAM Principles and Applications/PN Rao / McGraw-Hill
2. Automation, Production systems & Computer integrated Manufacturing/ M.P. Groover/Pearson Education

References:

1. Mastering CAD / CAM / Ibrahim Zeid / McGraw-Hill
2. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
3. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson learning, Inc

Course Code	POWER PLANT ENGINEERING	L	T	P	C
18ME7T4	Maximum expected contact hours : **64** Prerequisites :Applied Thermodynamics.	4	--	--	3

PURPOSE: generation of Power Using Different Sources.

INSTRUCTIONAL COURSE OBJECTIVES

1	The course is aimed at providing knowledge of power generation through different prime movers viz steam, ICGT, Hydro, nuclear and hybrid systems along with their economics and environmental considerations.
2	Describe sources of energy and types of power plants.
3	Analyze different types of steam cycles and estimate efficiencies in a steam power plant.
4	Describe basic working principles of gas turbine and diesel engine power plants.
5	Define the performance characteristics and components of such power plants.
6	List the principal components and types of nuclear reactors.
7	Evaluate cycle efficiency and performance of a gas cooled reactor power plant.
8	Classify different types of coupled vapor cycles and list the advantages of combined cycles power plant.

COURSE OUTCOMES

1	After undergoing this course the student can understand various conventional methods of power generation and principle of operation and performance of respective prime movers along with their economics and their impact on environment.

UNIT – I Introduction to the sources of energy – resources and development of power in india.

STEAM POWER PLANT: Plant layout, working of different circuits, fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, cooling towers and heat rejection. corrosion and feed water treatment.

UNIT – II INTERNAL COMBUSTION AND GAS TURBINE POWER PLANTS:

DIESEL POWER PLANT: Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging.

GAS TURBINE PLANT: Introduction – classification - construction – layout with auxiliaries, combined cycle power plants and comparison

UNIT – III HYDRO ELECTRIC POWER PLANT: Water power – hydrological cycle / flow measurement – drainage area characteristics – hydrographs – storage and pondage – classification of dams and spill ways.

HYDRO PROJECTS AND PLANT: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants

UNIT – IV NUCLEAR POWER STATION: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breederreactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

UNIT – V COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro-electric and gas turbine stations, co-ordination of hydro-electric and nuclear power stations, co-ordination of different types of power plants.

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements

UNIT – VI POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises. effluents from power plants and Impact on environment – pollutants and pollution standards – methods of pollution control.

Text Books:

1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai & Co.
2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub

References:

1. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
2. Power station Engineering – ElWakil / McGrawHill.
3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers

Course Code	PRODUCTION PLANNING AND CONTROL	L	T	P	C
18ME7T5	Maximum expected contact hours : **64** Prerequisites : Manufacturing Engineering, Industrial Engineering and Management	4	--	--	3

PURPOSE: The **process** of production itself is at the centre of the whole business operation. Production planning and control includes planning, steering, consigning and following up functions in the manufacturing **process** so as to ensure maximum **capacity**.

INSTRUCTIONAL COURSE OBJECTIVES	
1	An understanding of the concepts of production and service systems;
2	The ability to apply principles and techniques in the design, planning and control of these systems to optimise/make best use of resources in achieving their objectives.
3	Identify different strategies employed in manufacturing and service industries to plan production and control inventory.
4	Measure the effectiveness, identify likely areas for improvement,develop and implement improved planning and control methods for production systems.

COURSE OUTCOMES	
1	Recognize the objectives, functions, applications of PPC and forecasting techniques.
2	Explain different Inventory control techniques.
3	Solve routing and scheduling problems
4	Summarize various aggregate production planning techniques.
5	Describe way of integrating different departments to execute PPC functions

UNIT – I Introduction: Definition – objectives and functions of production planning and control – elements of production control – types of production – organization of production planning and control department – internal organization of department.

UNIT – II Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques – qualitative methods and quantitive methods.

UNIT – III Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems Introduction to MRP I, MRP II, ERP, LOB (Line of Balance), JIT and KANBAN system.

UNIT – IV Routing – definition – routing procedure –route sheets – bill of material – factors affecting routing procedure, schedule –definition – difference with loading

UNIT – V Scheduling policies – techniques, standard scheduling methods.Line Balancing, aggregate planning, chase planning, expediting, controlling aspects.

UNIT – VI Dispatching – activities of dispatcher – dispatching procedure – follow up – definition – reason for existence of functions – types of follow up, applications of computer in production planning and control.

Text Books:

1. Elements of Production Planning and Control / Samuel Eilon/Universal Book Corp.
2. Manufacturing, Planning and Control/Partik Jonsson Stig-Arne Mattsson/TataMcGrawHill

References:

1. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller/Prentice-Hall
2. Production Planning and Control/Mukhopadyay/PHI.
3. Production Control A Quantitative Approach / John E. Biegel/Prentice-Hall
4. Production Control / Franklin G Moore & Ronald Jablonski/ Mc-GrawHill
5. Production and Operations Management/Shailendra Kale/McGraw Hill
6. Production and Operations Management/Ajay K Garg/McGraw Hill

Course Code	COMPUTATIONAL FLUID DYNAMICS (Elective V)	L	T	P	C
18ME7T6A	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : **Engineering mathematics,Basic Thermodynamics, Flud mechanics, Heat Transfer**				

PURPOSE: Computational fluid dynamics (CFD) is a branch of fluid mechanics that uses numerical **analysis** and data structures to solve and analyze problems that involve fluid flows.

INSTRUCTIONAL COURSE OBJECTIVES

1	The course aims at providing required numerical and software techniques for solving various engineering problems involving fluid flow.

COURSE OUTCOMES

1	After undergoing the course the student shall be able to apply various numerical tools like finite volume, finite difference etc for solving the different fluid flow heat transfer problems.

UNIT-I

ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, convergence of sequences.

UNIT – II

APPLIED NUMERICAL METHODS: Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices.

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, conservation of mass, Newton's second law of motion, expanded forms of navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

UNIT – III

Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function - vorticity formulation.

Finite difference applications in heat conduction and convention – heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

UNIT – IV

Finite differences, discretization, consistency, stability, and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT – V

Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme.

UNIT –VI

FINITE VOLUME METHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

Text Books:

1. Numerical heat transfer and fluid flow / Suhas V. Patankar/Butter-worth Publishers
2. Computational fluid dynamics - Basics with applications /John. D. Anderson / Mc Graw Hill.

References:

1. Computational Fluid Flow and Heat Transfer/ Niyogi/Pearson Publications
2. Fundamentals of Computational Fluid Dynamics /Tapan K. Sengupta / Universities Press.
3. Computational fluid dynamics: An introduction, 3rd edition/John.F Wendt/Springer publishers.

Course Code	Condition Monitoring (Elective V)	L	T	P	C
18ME7T6B	Maximum expected contact hours : 64	4	--	--	3
	Prerequisites : Vibrations				

PURPOSE: Condition monitoring starts with using permanently installed sensors to collect data which is then used to analyse changes in the performance or condition of a machine component while it is in operation.

INSTRUCTIONAL COURSE OBJECTIVES

1	This course is designed to introduce the benefits and opportunities of health Monitoring and covers a range of techniques.
2	The students will be exposed to a range of techniques from Vibration based methods, Thermography, Oil conditions, Debris and ultrasonic monitoring
3	Using overall vibration, vibration limit zones, broadband vibration bandwidth, alert levels, typical severity guidelines, recording overall vibration, using overall vibration for fault finding, trending overall vibration.
4	Identifying Resonance, Hammer Test, Self Excitation, Exciter Testing. Reducing Resonance - Effects of Frequency, Stiffness, Mass, Damping, Isolation
5	

COURSE OUTCOMES

1	Gaining invaluable insights into the benefits of Condition Monitoring
2	Understanding the reasons for selecting particular maintenance strategies
3	Understanding effective methodologies for implementing Condition Monitoring Techniques
4	Identifying the optimum maintenance strategy for different types of equipment
5	Gaining practical approaches to minimize the risk of plant and machinery breakdowns.
6	Awareness of International Standards covering asset management

UNIT-I BASICS OF VIBRATION: Basic motion: amplitudes, period, frequency, basic parameters: displacement, velocity, acceleration, units (including dB scales) and conversions, Mass, spring and damper concept, Introduction to SDOF and MDOF systems, Natural frequencies and resonance, Forced response.

UNIT-II VIBRATION MEASUREMENTS AND ANALYSIS: Transducers and mounting methods, data acquisition using instrumentation recorders/data loggers, time domain signal analysis, orbit analysis, Filters, Frequency domain analysis (Narrow band FFT analysis), Nyquist criteria, Sampling, aliasing, windowing and averaging.

VIBRATION MEASUREMENT AND ANALYSIS: Use of phase; bode, polar and water fall plots, constant percentage band width analysis (1/3 and 1/1 Octave analysis), envelope detection /spike energy analysis, cepstral analysis, advances in analysis (PC based and portable instruments for vibration analysis).

UNIT-III Fault Diagnosis, Interpreting vibration measurements for common machine faults , imbalance, misalignment, mechanical looseness, bearing and gearing faults, faults in induction motors, resonances, some case studies, static and dynamic balancing, international standards for vibration condition monitoring.

UNIT-IV THERMOGRAPHY: The basics of infrared thermography, differences in equipment and specific wave length limitations, application of ir to: electrical inspection, mechanical inspection, energy conservation, how to take good thermal images, hands-on demonstrations focusing on proper camera settings and image interpretation,

analysis of thermal images and report generation, study of thermo graphy applications

UNIT-V OIL AND WEAR DEBRIS ANALYSIS: Basics of oil analysis, monitoring condition of oil, lubricant analysis, physio – chemical properties, moisture, tan tbn, wear debris analysis, particle counting, spectroscopy, uses & limitations, ferrography wear particle analysis, concept of ferrography, principle particle classification, size, shape, composition, concentration, analysis procedure, sampling & analytical ferrography equipments, severity rating.

UNIT-VI ULTRASONIC MONITORING AND ANALYSIS: Ultrasonic monitoring (leak, crack and thickness) basics of ultrasonic monitoring , ultrasonic theory, test taking philosophy, ultrasonic theory, mathematics of ultrasound, equipment and transducers, inspection parameters and calibration, immersion theory, equipment quality control, flaw origins and inspection methods, UT Procedure familiarization, and study recommendations, application of ultrasound to: air leaks, steam trap testing, bearing lubrication, electrical inspection, case studies.

Text Books:

1. The Vibration Analysis Handbook/J I Taylor (1994)/Vibration consultants Incorporate Publishers
2. Machinery Vibration Condition Monitoring/Lynn/Butterworth(1989)

References:

1. Machinery Vibration: Measurement and Analysis/Victor Wowk/Mc GrawHill Professional
2. Mechanical fault diagnosis and condition monitoring/RA Collacott(1977) /Chapman and Hall
3. The Vibration Monitoring Handbook/Charles W Reeves/Coxmoor publishing company

Course Code	Additive Manufacturing (Elective V)	L	T	P	C
18ME7T6C	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : Manufacturing Technology-1&2				

PURPOSE: Manufacturing of complicated shapes.	
INSTRUCTIONAL COURSE OBJECTIVES	
1	The course aims at the importance of Additive Manufacturing, classifications, models, specifications of various Additive Manufacturing Techniques. To learn the different tools, soft-wares required and the applications of Additive Manufacturing.
COURSE OUTCOMES	
1	The student shall be able to identify the use of Rapid Prototyping Techniques in the manufacturing of complex components that are otherwise very difficult to manufacture.

UNIT – I INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-II SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT – III POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-IV RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT – V RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.

RAPID PROTOTYPING SOFTWARE'S: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT –VI RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

Text Books:

1. Rapid prototyping: Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific publications

References:

1. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
2. Wohlers Report 2000 /Terry T Wohlers/Wohlers Associates
3. Rapid Prototyping & Manufacturing / Paul F.Jacobs/ASME Press
4. Rapid Prototyping / Chua & Liou

Course Code	Simulation Lab	L	T	P	C
18ME7L1	Maximum expected contact hours : **48** Prerequisites : Computer Basics and AutoCAD	0	--	3	1

PURPOSE: Design and Analysis of Static, Dynamic And Heat Transfer Problems.	
INSTRUCTIONAL COURSE OBJECTIVES	
1	To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation
2	To know various fields of engineering where these tools can be effectively used to improve the output of a product.
3	To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.
COURSE OUTCOMES	
1	The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
2	Use of these tools for any engineering and real time applications
3	Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems with confidence when it matters to use these tools in their Employment

1. DRAFTING:

Development of part drawings for various components in the form of orthographic and isometric representation of dimensioning and tolerances scanning and plotting. study of script, DXE and IGES files.

2. PART MODELING:

Generation of various 3D models through protrusion, revolve, shell sweep. Creation of various features. study of parent child relation. feature based and boolean based modelling surface and assembly modelling. study of various standard translators. design simple components.

3. a) Determination of deflection and stresses in 2D and 3D trusses and beams.
b) Determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axisymmetric components.
c) Determination of stresses in 3D and shell structures (at least one example in each case)
d) Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
e) Steady state heat transfer Analysis of plane and Axisymmetric components.

4. a) Study of various post processors used in NC Machines.
b) Machining of simple components on NC lathe and Mill by transferring NC Code / from a CAM package. Through RS 232.
c) Practice on CNC Sinutrain Turning
d) Practice on CNC Sinutrain Milling
e) CNC programming for turned components using FANUC Controller
f) CNC programming for milled components using FANUC Controller
g) Automated CNC Tool path & G-Code generation using Pro/E/MasterCAM

Packages to be provided to cater to drafting, modeling & analysis from the following:

CATIA, Pro-E, I-DEAS, ANSYS, NISA, CAEFEM, Gibbs CAM, Master CAM etc.

Course Code **18ME8T1**	**UNCONVENTIONAL MACHINING PROCESSES**	**L**	**T**	**P**	**C**
	Maximum expected contact hours : **60** Prerequisites : Manufacturing technology	**4**	**--**	**--**	**3**

PURPOSE: This course aims at study of different methods of unconventional machining processes.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To understand the concepts of various unconventional machining processes.
2	To familiarize the use of electrical energy in unconventional machining process.
3	Get acquitted with electrical discharge machining processes.
COURSE OUTCOMES	
1	Apply fundamental principles in machining special materials.
2	Solve most relevant industrial solutions pertaining to machining of hard materials
3	Design soft tools for machining hard materials.

UNIT-I- INTRODUCTION: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications
MECHANICAL PROCESSES: Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT-II-Abrasive jet machining, Water jet machining and abrasive water jet machine: Basic principles, equipment's, process variables, mechanics of metal removal, MRR, application and limitations. Magnetic abrasive finishing, Abrasive flow finishing

UNIT-III-THERMO ELECTRIC PROCESSES: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT-IV- Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT-V-Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT-VI-ELECTRO CHEMICAL & CHEMICAL PROCESSES: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and de-burring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate, Electro stream drilling, Shaped tube electrolytic machining. Fundamentals of chemical machining, Chemical machining principle, maskants, etchants, advantages and applications of chemical machining.

Text Books:
1. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH**.**
Reference Books:
1. Advanced machining processes by VK Jain/ Allied publishers
2. M.K.Singh, Unconventional Manufacturing Processes / New age international.
3. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984

Course Code	AUTOMOBILE ENGINEERING	L	T	P	C
18ME8T2	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : ICGT, Thermal Engineering				

PURPOSE: This course aimed to develop an Idea regarding Automobiles functionality and to identify the basic parts and engine systems.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To understand components of an automobile and functions of each component.
2	To learn working of fuel injection pumps and advanced injection systems used.
3	To understand detailed study of sensors and modern Ignition systems
4	To understand the working of transmission system components.
5	To acquire knowledge about suspension and braking systems in automobiles and Concept of steering geometry related to Vehicle dynamics applications.
COURSE OUTCOMES	
1	Develop different components of an automobile.
2	Develop the fuel feed systems in SI and CI engines, Sensors and Ignition systems.
3	Design various transmission systems.
4	Analyze the simple design oriented problems related to suspension systems, steering systems and braking systems.

UNIT-I- **Introduction:** Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarbonisation, Nitriding of crank shaft.

UNIT-II- **Fuel System:**
S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters– carburettor – types – air filters – petrol injection.
C.I. Engines: Requirements of diesel injection systems, types of injection systems, fuel pump,nozzle, spray formation, injection timing, testing of fuel pumps.
Emission from Automobiles: Pollution standards National and international – Pollution Control

UNIT-III- **Cooling System:** Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – antifreeze solutions.
Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

UNIT-IV- Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box , over drive torque converter.
Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles –types – wheels and tyres.

UNIT-V- Steering System: Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT-VI-Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. Breaking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Text Books:

1. Dr. Kirpal Singh, Automobile Engineering-Vol I& II, 12th Edition, Standard Publishers distributors, 2011.
2. William H Crouse and Donald L Anglin, Automotive Mechanics, 10th Edition, The McGraw-hill companies, 2008.

Reference Books:

1. R.B.Gupta, Automobile Engineering, 8th edition, Tech India publication series, 2013
2. Automotive Engineering / Newton Steeds & Garrett
3. Automotive Mechanics / G.B.S. Narang
4. Automotive Mechanics / Heitner
5. Automotive Engines / Srinivasan
6. Automobile Engineering – K.K. Ramalingam / Scitech Publications (India) PVT. LTD.

Course Code	Advanced Materials (Elective VI)	L	T	P	C
18ME8T3A	Maximum expected contact hours : **64**	**4**	**--**	**--**	**3**
	Prerequisites : Metallurgy and Material Science				

PURPOSE: Additive Manufacturing refers to a process by which digital 3D design data is used to build up a component in layers by depositing material.Instead of milling a workpiece from solid block, for example, Additive Manufacturing builds up components layer by layer using materials which are available in fine powder form.

INSTRUCTIONAL COURSE OBJECTIVES

1	The objective for this course is to understand the mechanics of different materials. This understanding will include concepts such as anisotropic material behavior, constituent properties and manufacturing processes of different composites. Suitability of smart and nano materials for engineering applications.

COURSE OUTCOMES

1	Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies.
2	Describe different RP techniques.
3	Discuss fundamentals of Reverse Engineering.

UNIT-I INTRODUCTION TO COMPOSITE MATERIALS: Introduction, classification: polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiberreinforced composites and nature-made composites, and applications .

REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres.

UNIT-II Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.

UNIT-III MANUFACTURING METHODS: Autoclave, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM.

UNIT-IV MACROMECHANICAL ANALYSIS OF A LAMINA: Introduction, generalized Hooke's law, reduction of Hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.

UNIT-V FUNCTIONALLY GRADED MATERIALS: Types of functionally graded materials-classificationdifferent systems-preparation-properties and applications of functionally graded materials.

SHAPE MEMORY ALLOYS: Introduction-shape memory effect-classification of shape memory alloyscomposition- properties and applications of shape memory alloys.

UNIT-VI NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages-applications in comparison with bulk materials (nano – structure, wires, tubes, composites). state of art nano advanced- topic delivered by student.

Text Books:

1. Nano material /A.K. Bandyopadyay/New age Publishers
2. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
3. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press

References:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van Nostrand Rainfold,NY 1969
3. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience,New York, 1980
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /Autar K.Kaw / CRC Press

Course Code	Design for Manufacture (Elective VI)	L	T	P	C
18ME8T3B	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites:Manufacturing technology,machine design				

PURPOSE: Design for Manufacturing (DFM) is the process of designing parts, components or products for ease of manufacturing with an end goal of making a better product at a **lower** cost. This is done by simplifying, optimizing and refining the product design.

INSTRUCTIONAL COURSE OBJECTIVES	
1	Understand the design rules and considerations with reference to various manufacturing processes
2	To discusses capabilities and limitations of each manufacturing process in relation to part design and cost
3	To examine DFM principles including how the design affects manufacturing cost, lean manufacturing, six sigma, etc.
COURSE OUTCOMES	
1	Design components for machining
2	Simulate the casting design and choose the best casting process for a specific product.
3	Evaluate the effect of thermal stresses in weld joints
4	Design components for sheet metal work by understanding in depth the sheet metal processes and their formation mechanisms
5	Design plastic components for machining and joining and selecting a proper processes for different joining cases

UNIT – I Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design. Design for the life cycle total product life of consumer goods-design considerations.

UNIT – II Machining processes: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

UNIT – IV Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – V Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT – VI Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Text Books:

1. Design for manufacture / John cobert / Adisson Wesley. 1995
2. Design for Manufacture / Boothroyd/CRC Press
3. Design for manufacture/ James Bralla/McGrawHill Edition

Reference:

1. ASM Hand book Vol.20

Course Code	Gas Dynamics & Jet Propulsion (Elective VI)	L	T	P	C
18ME8T3C	Maximum expected contact hours : **64**	4	--	--	3
	Prerequisites : Thermodynamics, Fluid mechanics.				

PURPOSE: Students can analyse the dynamic parameters in gas flows through various engineering equipment and can identify and evaluate various jet propulsion systems.

	INSTRUCTIONAL COURSE OBJECTIVES
1	The purpose of this course is to provide the student with the knowledge of basic principles of gas dynamics and its importance in jet propulsion applications.
	COURSE OUTCOMES
1	Up on successful completion of this course the student should be able to analyze the gas flow in different situations with and without friction, with and without heat transfer in particular jet propulsion and rocket engineering applications.

UNIT-I Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity – mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - general features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT-II Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and densitystagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters- chocking convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

UNIT- III Simple frictional flow: adiabatic flow with friction in a constant area duct-governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.

UNIT-IV Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

UNIT- V Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems.

UNIT-VI Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion – rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems.

Text Books:

1. Compressible fluid flow /A. H. Shapiro / Ronald Press Co., 1953
2. Fundamentals of compressible flow with aircraft and rocket propulsion/S. M. Yahya/New Age international Publishers
3. Fundamental of Gas dynamics-2nd edition/ M J Zucker/ Wiley publishers

References:

1. Elements of gas dynamics / HW Liepman & A Roshko/Wiley
2. Aircraft & Missile propulsion /MJ Zucrow/Wiley
3. Gas dynamics / M.J. Zucrow & Joe D.Holfman / Krieger Publishers

Course Code	Thermal Equipment Design (ELECTIVE VI)	L	T	P	C
18ME8T4A	Maximum expected contact hours : **60**				
	Prerequisites : Basics of Thermodynamics and Thermal Engineering	4	--	--	3

PURPOSE: To understand the basics of Thermal design and equipment cost management	
INSTRUCTIONAL COURSE OBJECTIVES	
1	Students will be able to learn the design concepts and fundamental aspects of industrial thermal system simulation and optimization.
2	Students will be able to exam optimum design criteria, their application and scrutiny of engineering decision.
COURSE OUTCOMES	
1	Ability to learn basic principles of Thermal design
2	Learning the cost analysis
3	Basic modelling knowledge about subjects of applied thermodynamics and heat transfer such as heat exchangers, evaporators, condensers, boilers, condensation of binary mixtures and turbo machinery
4	Ability of constructing the simulation of thermal systems
5	Learning the basic of optimum system design

UNIT - I:

Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasket plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.

UNIT - II:

Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations.

Double Pipe Heat Exchanger: Film Coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.

UNIT - III:

Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

UNIT - IV:

Condensation of single vapours: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – subcooler, vertical reflux type condenser, condensation of steam.

UNIT – V:

Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler.

Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.

UNIT - VI:

Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements,

Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

BOOKS RECOMMENDED:

1. J.P.Holman, “Heat Transfer”, McGraw Hill Book Co. Special Indian 9th Edition, 2008
2. Oziski, M. N. “Heat Transfer – A Basic Approach”, McGraw Hill, N. Y., 2001.
3. Roshenow, W., Hartnett, J., Ganic, P., “Hand Book of Heat Transfer ”, Vol. 1 & 2, McGraw Hill, N. Y., 2002.
4. Incropera & Hewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley , 2000.
5. S.P.Sukhatme, “Heat Transfer”, Orient Longman, 2001

Course Code	NON DESTRUCTIVE EVALUATION (ELECTIVE VI)	L	T	P	C
18ME8T4B	Maximum expected contact hours : **60**				
	Prerequisites :knowledge in conventional and unconventional machining processes	4	--	--	3

PURPOSE: To provide a basic understanding with case studies on different surface NDE techniques and apply them for inspecting materials

	INSTRUCTIONAL COURSE OBJECTIVES
1	To provide a basic understanding with case studies on different surface NDE techniques and apply them for inspecting materials in accordance with industry specifications and standards
2	To introduce students to a variety of practical applications associated with ultrasonic testing and the course is especially designed to provide a sound theoretical knowledge and practical skill for Ultrasonic testing.
	COURSE OUTCOMES
1	Comprehensive, theory based understanding of the techniques and methods of non-destructive testing.
2	Apply methods knowledge of non-destructive testing to evaluate products of railways, automobiles, aircrafts, chemical industries etc

UNIT-I- OVERVIEW OF NDT - NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, various physical characteristics of materials and their applications in NDT. Visual inspection – Unaided and aided.

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UNIT-II- SURFACE NDE METHODS -Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT-III- THERMOGRAPHY AND EDDY CURRENT TESTING -Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT-IV- ULTRASONIC TESTING AND ACOUSTIC EMISSION -Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

UNIT-V RADIOGRAPHY -Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

UNIT-VI- Magnetic Particle Test:

Magnetic Materials, Magnetization of Materials , Demagnetization of Materials,Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test**.**

Text Books:

1. Non destructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers
2. Ultrasonic testing of materials/ H Krautkramer/Springer
3. Non destructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4. Nondestructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

Reference Books:

1. Ultrasonic inspection training for NDT/ E. A. Gingel/Prometheus Press,
2. ASTM Standards, Vol 3.01, Metals and alloys
3. Non-destructive, Hand Book – R. Hamchand

Course Code	QUALITY AND RELIABILITY ENGINEERING (ELECTIVE VI)	L	T	P	C
18ME8T4C	Maximum expected contact hours : **60**	**4**	**--**	**--**	**3**
	Prerequisites : IEM, Management Basics				

PURPOSE: To provide the students with an overview about total quality management and reliability study.

INSTRUCTIONAL COURSE OBJECTIVES	
1	To Introduce The Concept Of SQC
2	To Understand Process Control And Acceptance Sampling Procedure And Their Application
3	To Learn The Concept Of Reliability
COURSE OUTCOMES	
1	Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability
2	Use control charts to analyze for improving the process quality
3	Describe different sampling plans
4	Acquire basic knowledge of total quality management
5	Understand the concepts of reliability and maintainability

UNIT-I- INTRODUCTION AND PROCESS CONTROL FOR VARIABLES - Introduction, Definition Of Quality, Basic Concept Of Quality, Definition Of SQC, Benefits And Limitation Of SQC, Quality Assurance, Quality Control: Quality Cost-Variation In Process Causes Of Variation –Theory Of Control Chart- Uses Of Control Chart – Control Chart For Variables – X Chart, R Chart And σChart -Process Capability – Process Capability Studies And Simple Problems. Six Sigma Concepts

UNIT-II- PROCESS CONTROL FOR ATTRIBUTES - Control Chart For Attributes –Control Chart For Non Conformings– P Chart And Np Chart – Control Chart For Nonconformities– C And U Charts, State Of Control And Process Out Of Control Identification In Charts, Pattern Study.

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UNIT-III- ACCEPTANCE SAMPLING - Lot By Lot Sampling – Types – Probability Of Acceptance In Single, Double, Multiple Sampling Techniques – O.C. Curves – Producer"S Risk And Consumer"S Risk. AQL, LTPD, AOQL Concepts-Standard Sampling Plans For AQL And LTPD- Uses Of Standard Sampling Plans.

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UNIT-IV- LIFE TESTING –Life Testing – Objective – Failure Data Analysis, Mean Failure Rate, Mean Time To Failure, Mean Time Between Failure, Hazard Rate – Weibull Model

UNIT-V RELIABILITY - System Reliability, Series, Parallel And Mixed Configuration – Simple Problems. Maintainability And Availability – Simple Problems. Acceptance Sampling Based On Reliability Test – O.C Curves

UNIT-VI- QUALITY AND RELIABLITY - Reliability Improvements – Techniques- Use Of Pareto Analysis – Design For Reliability – Redundancy Unit And Standby Redundancy – Optimization In Reliability – Product Design – Product Analysis – Product Development – Product Life Cycles.

Text Books:

1. Douglas.C. Montgomery, " Introduction To Statistical Quality Control", 4th Edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East West Press, 1991

Reference Books:

1. John.S. Oakland. "Statistical Process Control", 5th Edition, Elsevier, 2005
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
5. Gupta. R.C, "Statistical Quality Control", Khanna Publishers, 1997.
6. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
7. Sharma S.C., "Inspection Quality Control And Reliability", Khanna Publishers, 1998.
8. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991